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ABSTRACT

Presented are proceedings and supplementary reports of the Midwest School Transportation Fleet Management Seminar, which was held in Lansing, Michigan, November 28-29, 1979. Among the school bus energy management topics discussed are energy feasibility studies, the use of programmed information systems, energy conservation strategies, and technical improvements. In addition to transcripts of these presentations, this handbook includes summaries of group discussion sessions and reports submitted by school transportation officials on results of their school bus energy conservation programs. (WB)

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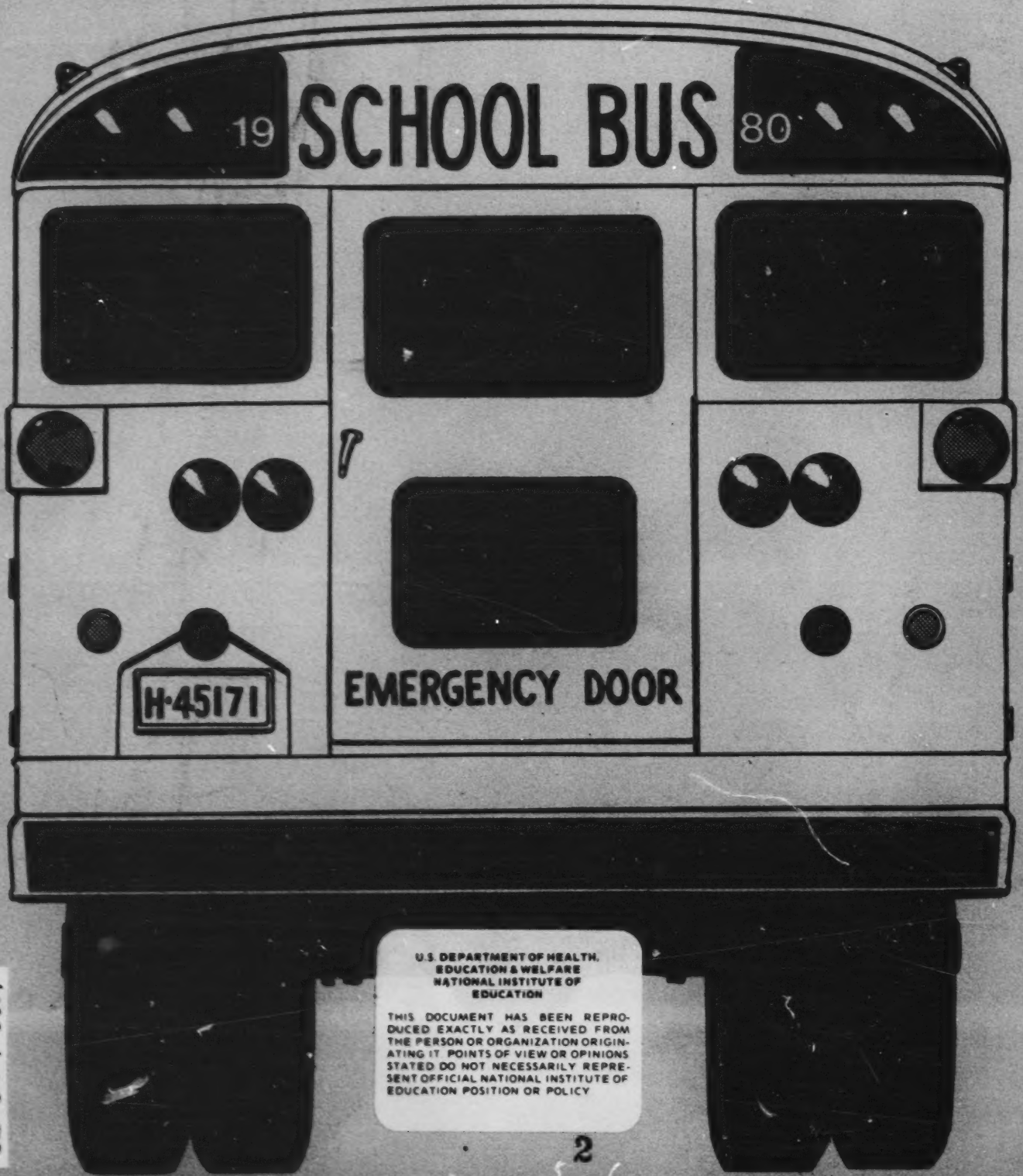
Focus on Energy

A SCHOOL TRANSPORTATION HANDBOOK

Energy Administration
Michigan Department of Commerce
November, 1979



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FOCUS ON ENERGY:

A School Transportation Handbook

Proceedings of the Midwest School Transportation
Fleet Management Seminar
November 28-29, 1979
LANSING, MICHIGAN

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INTRODUCTION

On November 28th and 29th, 1979, the Michigan Department of Commerce, Energy Administration and Department of Education sponsored the Midwest School Transportation Fleet Management Seminar - Focus on Energy. Approximately 30 representatives from six states, Michigan, Ohio, Illinois, Wisconsin, Minnesota and Indiana were in attendance. Speakers from both the public and private sectors discussed a wide variety of school bus energy management topics, including new technical improvements, energy feasibility studies and the use of programmed information systems in energy fleet management.

The school transportation officials who attended were asked to submit written reports on what they have done in school bus energy management together with the results of such applications. These reports, along with edited transcripts of the sessions, are included in this handbook.

The seminar's goals were to both gather and disseminate information on energy fleet management, so the group was comprised of school transportation officials who have demonstrated previous expertise in this area. They came together in Lansing to learn from each other and to share information through this handbook. The limited number of participants encouraged group discussion. Those on hand agreed more emphasis needs to be put on school transportation energy management. The seminar and this handbook are initial steps in this direction.

OVERVIEW

This overview is designed to quickly give the reader an idea of what each speaker discussed.

Dr. Robert Muth, Executive Secretary of the Michigan School Business Officials (517-355-1720) spoke on the scope and depth of the energy problem facing school transportation officials. Members of his staff also moderated a group discussion on school bus fleet energy management. The proposals generated by this discussion appear as Appendix One.

William Myatt of Detroit Diesel Allison (313-565-0411) gave a presentation on a new fuel-efficient diesel engine, now available through chassis manufacturers, including General Motors Corporation, International Harvester and Ford.

Hanford Combes of School Transportation Systems, Inc., (614-891-6696) discussed methods of performing effective energy management feasibility studies. His "102 Ways to Conserve Energy" and "Fuel Economy through Teamwork" appear as Appendix Two and Appendix Three.

John Rankin of the Mainstem Corporation (614-237-9710) discussed the use of programmed information to help vehicle fleets contain costs. An article from "School Bus Fleet Magazine" on Mainstem appears as Appendix Four.

Larry Louderback of the Michigan Department of Education, School Support Services Division (517-373-3314) described problems encountered and solutions proposed by his office for Michigan school transportation systems.

William Sulak of the U.S. Department of Transportation's Voluntary Truck and Bus Fuel Economy Program (202-426-9502) described possible technical improvements in buses and discussed effective purchasing techniques and driver motivation. He showed a film on bus driver motivation entitled, "Who Cares?" A leaflet on the movie appears as Appendix Five.

U.S. Department of Energy Region V official Kenneth Johnson gave the concluding remarks, describing what DOE has done in the past and hopes to do in the future regarding school transportation.

Participating school transportation officials were asked to submit written reports describing what they have done to date in energy fleet management. These reports appear as Appendix Six.

Moderator for the seminar was Hank Doerr of the Energy Administration, Conservation Consumer Assistance Division. This handbook was edited by Hank Doerr and Joe McElroy of the Energy Administration.

THE ROLE OF SCHOOL TRANSPORTATION PROGRAMS IN ENERGY CONSERVATION

Dr. C. Robert Muth
Michigan State University

This is a gathering of experts in school transportation and experts in the conservation of energy in transportation. I am not going to belabor already known procedures or actions that result in energy savings -- everyone here is aware of the economics of efficient routing, or optimizing vehicle size with need, the advantages of diesel engines, the mileage benefits from radial tires, the driving patterns and operational procedures that extend each gallon of gas or the effectiveness of consistent and efficient maintenance programs.

Rather, I would like to talk with you about the magnitude of the total problem of which conservation in school transportation is but a part. Then I will want to direct your attention to three issues:

1. The contribution of the school transportation program to attitude development for understanding and accepting the challenge of a world short of fossil fuels -- the contribution toward energy awareness and action.
2. The part that a persistent transportation conservation program should play in a total energy management plan for the school district.
3. The need for a management program that will ensure that conservation knowledge and programs are welded into a system that will provide data for day to day decisions and long range planning.

And finally, I will ask you to participate in identifying the most significant problems deterring further progress in conservation in transportation -- the organizational or other inhibitors to greater progress -- and to make recommendations for policy changes that would eliminate or mitigate the inhibitors. Our job will be to seek out, organize, summarize, emphasize and disseminate the knowledge, experience and judgement that you bring to the overall question of how to improve and maintain optimum fuel economy in transporting children and how to contribute in creating a greater sense of urgency and commitment to energy independence in America? We will explain the process more fully a little later, but I ask now for your sincere participation.

There is a broadening consensus among scholars, government policymakers, and industry forecasters that the era of plentiful and inexpensive energy -- particularly oil -- is drawing rapidly to a close. But, even though the "Age of Oil" is a mere blip on the graph of human history, it is the era we have grown up in and in which our world view has been formed. Our highly technological industrial society has been built in less than a century on a foundation of liquid fossil fuels.

The structure of a society is determined in large measure by its energy foundation. Technologies -- including energy systems -- are never value neutral; rather they are primary determinants of culture and predispose a society toward specific patterns of living and thinking. The way we farm, develop resources, manufacture, distribute products, and even spend our leisure time are all based on our century's experience of cheap, plentiful energy. Our belief that progress is synonymous with technical and economic growth and that solutions to social problems are a natural by-product of that growth is founded in our past ability to bring into use unprecedented and expanding amounts of energy.

Now, this era is nearly over and most of us can barely imagine the transformation modern civilization faces. Pessimistic scenarios depict global famine as the world's burgeoning population approaches the limits imposed by declining energy resources and environmental degradation. Domestic anarchy and international conflict -- wars of "expropriation" by the rich nations and of "redistributive justice' by poor ones -- seem to loom on the horizon. Even if through extraordinary adaptability and good luck we avoid the worst of these disasters, our society will be dramatically changed by the new energy realities.

Unfortunately, a very human but tragic response is to deny the problem. The first widely publicized projections of our finite oil supplies, those by geologist King Hubbert in the 1950's, were dismissed with scorn by the oil companies. Though his data have proved correct, some still seek to discredit the conclusions. The distortion of energy realities is dangerous in that it implies that existing social institutions may find it very difficult to adapt to the energy challenge that faces us. In the fifty years prior to 1974-75 we used more and more energy per capita while its real cost in hours of work decreased. In the last five years the real cost of energy in relation to hourly wages has increased and will continue to increase. The price per gallon is directly related to conservation. Our inability or unwillingness to recognize the forewarnings of the 70's increases the need for major adjustments in the 80's and beyond.

Yes, the global energy supply is finite and diminishing in relation to demand and there are no magic sources of replacement. Most alternative sources of energy require such great energy input that the net energy produced is a small percentage of the inert energy within the natural resource. Compared to oil, alternative sources are a long way off and will be more costly.

In addition, half of our oil supply is foreign produced and we use twice as much energy per capita as Germany, the most comparable nation in terms of industrial production and standard of living. Some experts say that we could save

half of our energy consumption through aggressive conservation -- without effecting our real standard of living. Our administration, through statements of President Carter and Secretary of Energy Duncan, has rediscovered conservation. Secretary Duncan, in a recent speech in Detroit, said that conservation was the only current alternative to lower standards of living. Indeed, other experts have stated that if we don't achieve an annual 2½% reduction in energy consumption, starting now, the cost and scarcity of energy will disrupt our social and political structures to the point of domestic and international crisis. The sad irony of the situation is that we are still a favored nation in terms of energy resources -- oil and coal -- and in the other essential resources of water and agricultural land. If we don't survive as a democratic nation and as a world power it will be due to our lack of wisdom.

The Iranian situation has brought into focus the implications of an interdependent world of trade, lubricated with oil. The world now seems divided between industrial nations, OPEC nations, and underdeveloped emerging nations. Global population growth and the threat of increasing competition for locally available food, water, fuel, and other resources to achieve and maintain satisfactory levels of health and well being set the stage for forces which attempt to bring new adjustments. The widespread recognition of a change in America's relative political and economic leadership position has dynamic implication for our nation and to us as citizens.

If, in fact, the United States is at a social, economic, political and international crossroads which is keyed to our capacity to gain energy independence within a critical time frame, what is the responsibility and role of government education and what is the role of those concerned with transporting children to and from school? What is our responsibility for contributing to national awareness and commitment to conservation, to local commitment, to community commitment and participation? Now, certainly the transportation program of any single school district is not going to impact the nation or state. But the school transportation service is one of the most, if not the most, visible and recognizable service in the local community. In most communities across this nation education is the largest enterprise and, in all communities, the organization with the greatest community participation. Transportation as the most visible service of the community's most encompassing enterprise can play a leading role in energy conservation awareness and education -- it can provide leadership within the school district, and the school district can provide leadership to the community.

As stated earlier, I have three general concerns to present:

1. I believe our school transportation program needs improved management. I think it needs highly trained personnel, better management data and better management systems. The supervisor of transportation is too often a part-time function performed by a person placed on the job without specialized training. Many, many school transportation systems in Michigan, and I'm sure in other Great Lake States, involve more than forty buses and drivers, and transportation budgets of over $1,000,000 per year. It's time to give this growing, costly and community sensitive service better management. Data for day to day and week to week operations and long range planning are extremely limited. We need a better data base, we need personnel capable of making the system work.

2. I believe students should be informed about and involved in the conservation program. The transportation system can become a part of the total educational program of energy conservation. Why don't we take children more seriously as opinion setters? Children are the best teachers of parents, and they will become adults. How do you think the transportation program can involve students and contribute to the development of their sense of energy ethics?

3. I believe the transportation program and the personnel who manage it can dramatize and disseminate their efforts and achievements within the school staff and the community. Conservation achievements should be presented in an ongoing public information program. In most communities across this nation the school system is the leader in energy conservation efforts. Now, I believe, they must extend their leadership to the entire community through demonstration of their own success and through the development of curriculum that encourages individual family awareness and cooperation.

Conservation is essential to our very survival, and it must be achieved through individual knowledge and acceptance. Knowledge, awareness, and social sensitivity is our business, and every segment of our business must participate in this gigantic, but oh so important, endeavor. This nation is made up of 15,000 school districts -- we can make a difference!

LANSING, MICHIGAN
WEDNESDAY, NOVEMBER 28, 1979

PROCEEDINGS

MR. DOERR: This is the Midwest School Transportation Fleet Management Seminar - Focus On Energy. I would like to introduce Nancy Baerwaldt, the Acting Director of the Energy Administration. She will give the opening introduction.

MS. BAERWALDT: I must say we're here today because of a real concern in this increasingly important subject. I certainly don't need to take up your time trying to convince you of the severity of the petroleum situation. I'm sure all of you know the havoc that rising costs have plagued on your budgets, not to speak of the precarious situation of supply.

Why is the knowledge that we are going to gain in the next couple of days so important? The answer, I think, is quite simple. School transportation fleet management certainly can save school districts an awfully large amount of money. The facts are evident. One school district in Ohio indicated to us that they saved about 40 percent through fleet management techniques. A private trucking company reduced costs by about 20 percent.

Fleet management techniques, as will become abvious in the next couple of days, vary from the obious to the subtle, from the use of simple common sense to the adoption and understanding of complex new technology. Let's put the utilization of energy by school buses in perspective. Our data suggests that school buses consume about 350 million gallons of petroleum product or fuel a year and use about seven and a half million barrels. That's enough to keep the state of Michigan running for about a month. So, the use by school buses is substantial and the potential for savings is huge.

Of course, different transportation systems around the country need to use different fleet techniques. However, all districts need to take hard looks at purchasing, maintenance and operation of their bus fleets. A district might find it too expensive to undergo expensive equipment retrofitting, but it can still keep a close eye on preventive maintenance and promote good driving habits.

Let's just look at one fact to bring this home, if you will. Two spark plugs which misfire at one time in a V-8 can reduce mileage by up to 20 percent. I'm sure that most of you here today, simply because of your own interest, have been practicing energy saving fleet management habits. Almost everyone who has even worked a little bit with an engine has some ideas on how to cut down on cost. Saving fuel is now too important to be approached on the common sense personal hunch basis, however.

School transportation officials now need to approach it as a management science, a professional task just like the precision used to balance a school district's budget. Management cost effective techniques and modern technology are certainly available.

The average school bus in American consumes about 950 gallons of gasoline a year and gets seven and a half miles per gallon. Our goal here today is to help contain those costs and reduce energy consumption.

Since many school districts are being allocated less fuel this year than last this goal should, of course, have high priority. Don't expect everything to go smoothly. Any new program or efforts to improve operations that change something are bound to run into a few obstacles and problems, but please don't become discouraged. It's not easy to convince a veteran driver to change some of his/her habits. Routing changes may force children to walk further and, of course, this will be opposed by some parents.

I just want to say again welcome and thank you for participating in this two-day-long seminar.

MR. DOERR: Thank you. Welcoming remarks will be concluded by Phillip O'Leary from the Michigan Department of Education.

DR. O'LEARY: Since 1974 the public school districts in the state of Michigan have decreased 250 thousand students. That's exactly the same number that we have increased in transportation. As I told the State Board of Education we haven't lost them, we're just riding them around in buses all day long.

We at one time in 1974 were transporting about 41 or 42 percent of the kids to school. We're about 62 percent right now. Those of you in the other states, those that haven't had the mandatory special education implementation, this is going to take a chunk out of your budgets. We're finding nowthat as far as costs are concerned it costs approximately $1,200 to transport a special education youngster as opposed to $100 for a regular student.

I heard of an extreme case of $20,000 for one student to be transported to school. We've only gone as high as $12,000 for some student to be transported to school. Granted, some of these are cabs and some of these are small vehicles, but they still require gasoline. With the programs and services being scheduled based on an empty room rather than the needs of the children, we are continually asked to transport more.

We're in situation where we have schools closing, and as the schools close now pupils live more than a mile and a half, so now we are required to transport.

School districts that have experienced decreasing enrollment have had increasing transportation. And just because you lose 7,000 students in one district, you don't cut down on the buses by that percentage; it's almost remaining the same.

As Nancy indicated, we are a large user of gasoline in this state. We are a larger user of fuel oil, and, of course, electricity and the other energy sources.

I'm hoping that we can do something to take care of some of these problems that we're having. Even though there might be quantity I'm not sure we can afford it. 68.8 cents per gallon was the cost of gasoline in the state of Michigan on May 28, 1979. I did a check this morning with AAA and it is a $1.05 per gallon for regular. It had gone up 39 cents, a 50 percent increase since the end of May, and the schools are in the same situation. Schools paid 11 cents a gallon for gasoline in 1972. It costs the school district somewhere around 76 cents a gallon today, a 600 percent increase.

School budgets used to talk about the utilities being 2.4 percent of the budget. Now they are up to about 6.7 and 7.2 percent.

I'm happy to see that we have people who are experts in this field who are going to give us some suggestions. I hope that what we come out of this meeting with will be very useful to all of us involved and I would sure like to reduce that 35 million by about 10 million at least the first year.

MR. DOERR: Thank you. Our first presentation has a little story to it. We did invite Ford, GMC, and International Harvester, as well as Detroit Diesel Allison to participate and give a presentation on fuel economy. Unfortunately GMC, Ford and International Harvester could not make it. We have Bill Myatt from Detroit Diesel Allison who will be giving us a fuel pincher presentation.

MR. MYATT: In order to properly introduce the new General Motors Diesel engine which has been designed for medium duty vehicles, it's necessary to go back in history six or seven years. At that time, in the good old days, gasoline cost less than 30 cents a gallon. Diesel fuel cost 15 to 20 cents a gallon. And to be quite honest, people were not concerned with either fuel availability or the operating cost per mile. It wasn't economical to either build a diesel engine for medium size trucks or to operate one when you had to consider how long it would take to pay for the over-cost of the engine itself. And at that time, less than 3% of medium size chassis were operating with diesel engines.

Since then, the world has been shaken by events relating to both fuel availability and skyrocketing costs. But many economists were predicting what, in fact, would take place in the supply and cost of gasoline and diesel fuel. Six years ago is when General Motors made the decision to design and manufacture a diesel engine specifically for medium size chassis. Detroit Diesel Allison began to design both an engine and a manufacturing facility from what we would like to refer to as a clean sheet of paper -- no holds barred. It had to be a diesel engine which would

be economical for the customers to purchase in the early 1980, comply with all the federal and local noise and emission regulations, and provide the kind of fuel economy that would allow the typical medium chassis operator who was using gasoline power to pay for that overcost in a relatively short amount of time... about two years.

Several different engine configurations and concepts were explored and every possible engineering innovation was thoroughly pursued and weighed as to its advantages and disadvantages. What finally emerged is a four-cycle diesel engine that incorporates all the proven advantages of the two-cycle diesel engines that general motors has built by the virtual millions. All the modern innovations make it an engine as current in the state of the art as possible. Concurrently, the manufacturing facility was constructed to produce the engine to a high quality standard and yet at a price that would meet the original program objectives.

I would like to share with you a slide presentation which we have condensed so as not to bore you with all the nuts and bolts that it necessarily takes to build a modern diesel engine, but still enough to give you a feel for an engine which will set the pace in dieselizing America's medium size chassis.

The criteria for this engine was that: 1) It should have the durability to last as long as the average medium duty chassis lasts which, in the U.S. and Canada, is about 125,000 miles, and the average chassis operates about 17,500 miles a year during its seven year life. 2) The engine should be about the same physical size as the gasoline engine which it has been designed to replace, and, in order to keep the cost of the total vehicle as low as possible, the engine should use the same size cooling package that gasoline engine. 3) We wanted the engine to be as quiet as possible so that the chassis manufacturers wouldn't have to spend a great deal of additional money making it quiet enough to meet the regulations that we know are becoming a part of this business.

It also had to be affordable in its initial purchase price and provide the kind of fuel economy that would allow that initial purchase price to be returned to the operator within about two years of operation. And that return would be based only on fuel economy, and all the other inherent advantages that a diesel offers, lower maintenance and longer life would be pluses.

And the engine had to have a warranty that, in fact, stood behind the quality that was being built into the engine.

Let me share with you the specifications of the engine. There are two basic models -- A naturally aspirated at 165 horsepower, and a turbocharged at 205 horsepower. The naturally aspirated has peak torque of 350 pound feet, and the turbocharged 430 pound feet. Both engines are 90 degree V-8 with a 4.25 inch bore

and a 4.41 inch stroke. They are 500 cubic inch displacement engines which equates 8.2 liters. The naturally aspirated engine weighs 1,096 pounds and the turbo-charged 1,121 pounds. Both of these weights are approximately 300 pounds less than any other comparable horsepower diesel engines available for medium size chassis.

Let me show you just a few of the design features of this engine.

One of its important features is its unit fuel injection system. This is a patented design with an injector that performs all the functions of measuring, timing, pressurizing, and atomizing the fuel. This system eliminates the need for a high pressure fuel pump and all the associated high pressure fuel lines. And the injection system plays a major role in the engine's excellent fuel economy and its ease of maintenance. More than two million Detroit diesel engines prove the value of unit injectors everyday.

Using this principle as a basis, a new injector was designed specifically for this engine, and it incorporates some even further improvements. Such as the fact the fuel passages are now within the cylinder head, eliminating all outside plumbing and, obviously, eliminating the potential for leaks.

In this slide, you're looking down at the top of one cylinder bank of the block. Notice the cylinder bore walls are free standing and not connected to the top deck of the block. This design does two things. First, it prevents vibration noise from being transferred from the bore wall to the outside of the engine. And, secondly, it provides full length cylinder cooling top to bottom.

The cylinder block ends at the crankshaft centerline, eliminating a skirt which would tend to radiate vibration and noise.

In its place, a high rise double wall oil pan surrounds more of the crank-shaft. The sound dampening qualities of the double wall construction further help to reduce engine noise. Another unique feature is the oil pump located within the block at the front of the engine. This also helps reduce the new fuel pincher's noise level.

All fuel pincher engines come equipped with a premium plate type oil cooler to reduce engine oil temperature and provide extended oil life.

This slide shows the side of the engine with the exhaust manifold removed from the cylinder head. Focus your attention on the exhaust port indicated by the pencil. It incorporates a high technology stainless steel exhaust port shield.

This shield produces an air gap between the exhaust port and the cooling passes within the cylinder head. This reduces the exhaust heat being transferred to the cooling system. and is one of the features that enables the fuel pincher to use the same type of cooling system as the popular gasoline engine and helps keep that

initial cost down when compared to other diesels.

The piston dome incorporates a toroidal-shaped combustion chamber. This combines with a unit fuel injection system and helical-shaped air intake passages in the cylinder head to produce "Swirl Fire Combustion". Swirl fire combustion is unique to the fuel pincher. Swirl fire combustion allows the fuel pincher to achieve excellent fuel economy.

Swirl fire combustion is also responsible for the engine's excellent cold starting capabilities. The fuel pincher provides quick cold starting at temperatures down to 10 degrees without the use of any starting aids. For those areas that do require starting aids, of course, they are offered by the chassis manufacturers.

Now, let's talk about what is probably the engine's most important advantage. And that is its fuel economy. These slides show the results of various tests which were conducted comparing the fuel pincher to popular gasoline engines. From these, you can see we have achieved our goal of approximately twice as many miles per gallon of fuel as a gasoline engine doing the same job. Based on this, the calculations would show the fuel pincher engine will return its investment cost in approximately two years.

From this testing, we have also been able to demonstrate that the engine will operate for about 125,000 miles which, as you recall, is the life of the average medium size vehicle, before wear-out of major components. And, for those operators who might have a need for higher mileage, the engine is rebuildable when it does wear out. The block can be rebored, the crank can be reground, and all of the major components can be rebuilt.

Another aspect of the fuel pincher engine that I think is extremely important, especially to school bus operators, is the fact that both the naturally aspirated and the turbocharged fuel pinchers are compatible with Allison automatic transmissions.

To be quite honest, a school bus equipped with this diesel engine and an automatic transmission will not present different problems to the driver that he's currently experiencing in driving his own car.

With the kind of reliability being build into the new fuel pincher, it will have a fuel coverage warranty of 24 months or 50,000 miles, whichever comes first, with 100% coverage on parts and labor, including removal and reinstallation and the consumables that might be lost due to a failure. This compares to the typical 12 month, 12,000 mile warranty on gasoline engines.

Based on this, I'm sure you can see that we have, in fact, built a diesel engine which meets the criteria necessary for a medium duty vehicle.

1). It demonstrates the reliability that is needed.

2). It is the same size as a gasoline engine to fit in the same size chassis and uses the same type cooling system.

3). It is quiet enough to meet all of the regulations.

4). It provides the fuel economy that will offset the additional investment in this engine in about two years. The balance of the years of operation are all savings.

5). The warranty does support the product for a longer period of time than gasoline engines which are currently operating in school buses.

MR. DOERR: Our next speaker is "Mr. School Bus," and from the materials he has forwarded to us there is good reason for that title.

Mr. Combes has a long, impressive list of experiences. He is nationally recognized as an expert in the field of pupil transportation. Prior to becoming the president of School Tranportation Systems, Incorporated, he served one year as Vice President and Director of the School Tranportation Safety Division Institute for Safety Analysis in Washington, D.C. and ten years as Chief of Pupil Transportation in the state of Ohio, Department of Education.

In recent years he has conducted in excess of 40 university workshops and taught pupil transportation, management technology and transportation law; and served as special consultant to the Department of Health, Education and Welfare Regional Conferences. He has taught several transportation management law courses at the University of Cincinnati and Ohio University. Mr. Combes will speak on, "How to do an energy management feasibility study on school transportation systems."

MR. COMBES: It became obvious in the middle 50's when suburbia started to grow and the World War II baby boom hit our schools that there was going to be a lot of growth in the schools. School boards looked for raw property, outlying property, the cheapest property to construct buildings, not realizing this also presented a logistical problem, and they didn't realize in what magnitude.

School transportation suddenly was here. I would like to report to you that even today, in spite of the fact that this is the largest mass transportation system in the world, that we still find very, very few universities offering any course of instruction, any training in the management of this monster. $4.2 billion will be expended this year in school transportation.

We've got a problem, friends. The energy shortage is real. Now, I'm not certain it's real because of supply, but it is real because of politics, availability of light oils and a lot of other factors that exist: Pricing, price structures, transportation of supply and so forth have all added to the dilemma that we are in now. We're going to try to target in on a couple of specifics: Where we are in school transportation and what we can do about it? What steps we can take now? We'll get into the feasibility study and how it can be helpful to us.

One of our primary problems in dealing with school people and, I guess, it's true of most Americans today, is that we have been spoiled in this country. The average American still uses 30 times the energy of the citizen from most other countries. Now, I'm not saying that's necessarily bad, but it has been convenient, it has been economical, no cost problem in the past, and all of these things were changed.

The attitude I'm running into now is, "How I can continue doing what I am doing within a dollar constriction?" I'm not really talking about supply, although we keep hearing this thing coming in from the background.

The attitude has to be changed if we're going to do anything about it. And it's not going to be your attitude individually that is going to get the job done. It has to be a collective effort. That means re-education.

If we look at the logic of this thing, it simply isn't right to waste. So that's the first thing we have to get across to people. We have to conserve. Why use up fuels that are finite in resource and quantities? We know that fossil fuels have an end to them someday. We haven't nearly even reached those ends. We haven't even reached the ends in light oils, but the availability and the access is becoming a problem, and the price is going to be high.

We know that ten years downstream and perhaps even before that there are some solutions on the horizon; not cost solutions but supply solutions. We have more heavy crude locked in the tar sands of Canada and twenty-two states in this country and all over the world than all the light oil reserves that we know of or have ever used in this world, but they are hard to get out of the sands and the shale and so forth, and they are hard to refine. Just now the cost has reached a point to make it feasible to look at these sources. So the fossil fuel supply in the world holds a lot of promise for the future if that's the way we want to go.

There are other technologies opening up. Any student in high school physics can tell you about the energy locked up in every atom and molecule on this earth and releasing those things. We have started in this field. Those offer sources of energy for whatever uses we want to put it to.

Some of the sad commentary. If we stopped generating electricity by oil burning now, we could stop the imports from the Middle East tomorrow, and yet we are caught up in regulation and all kinds of things, some good, some impossible to understand, that dictate that we're going to continue burning vast amounts of oil to generate electricity even though we're sitting on probably the world's largest coal supply.

The Germans in World War II produced petrol, gasoline fuels almost entirely from their coal, and we're just now restudying those documents to see how they did it. So there are a lot of potential answers to supply.

I can't find any potential answer to high price. It is here to stay. The president of Exxon said recently, "No, a dollar a gallon is not what we need. We need a dollar and a half a gallon." In Michigan and other areas it is right across the dollar mark. By early spring they are predicting $1.20 per gallon; by next fall don't be surprised if you see $1.50 a gallon. So you better plan in that

direction in your school budgets.

Europe is paying two, three dollars; $4.50 in Italy, it's been that way for years. So if you try to go along with the logic that it is going to regulate itself when the price gets to a certain point, we haven't reached that point yet. Where is that point? When are you willing to give up the trip to get the family together on Thanksgiving?

Well, how about our vacation every year, our trips? If we have a problem we have to identify the problem, define it and then start doing things about it. And again, it is a total effort. It's not what we're going to do in school transportation; it's not what we're going to do individually; it is a collective, definable effort of listing priorities if this is a problem.

The unfortunate part is that the figures on total supply and transportation and availability and where it is stored and how much is refined do not belong to the federal government or state government; they belong to the international oil companies. Wasn't it interesting that after the international oil companies talked about their excessive profits this last report, they quickly pointed out, "Well most of those were made overseas." In other words, they sold to the European markets and the other markets where they are getting 3, 4, 5 dollars a gallon, oil being refined in this country and shipped right out to those markets.

I don't know how you feel about it. The more I read on it and talk to people and study it the more confusing it gets. No wonder we can't get straight answers from the government: they don't know any more than you or I do.

I'm kind of amused when Bill was talking about the energy efficiency of this engine and somebody else was talking about things you can do to conserve energy. I figured out one time that if you did all of the things that were possible to save energy you would have to find a place to sell fuel, because it would be 120 percent efficient. What we have to say is that if everything is operating at peak performance this is a saving potential, and anything under that you are wasting fuel.

Well, let's start where part of the problem exists. One state says in its law: "A school district is not obligated to provide any school transportation." And another state says elementary kids over two miles, and so on and so on from every state level. The state legislature is the big school board in every state; they pass the laws that operate the schools, and yet they say, "Let's keep that local autonomy. Let's keep that identification" and so forth. And then people from neighboring districts, go to church together and shop together say, "Well, your school board hauls high school kids; mine doesn't do that. Your school board

has a mile and a half -- anything over a mile and a half elementary, and mine is over a mile elementary," and then the state comes along and says, "Well, if you transport anything over a mile we'll reimburse you, at least a part of it or a percentage of it."

We have all kinds of conflict here. Number one, our state legislatures ought to pass laws that define school transportation and the limits. I don't want them to take over local operations, but I don't think it is fair to pass permissive legislation that shoves the final decision off on local boards that are having a tough time raising money to educate kids.

I think we ought to define very carefully who is eligible. It ought to be realistic, it ought to be practical and something we can live with, and then we ought to fund this on that basis partially; I'm not saying total funds.

The philosophy that we will give you a percent reimbursement because that's an incentive to save is not true. That's an incentive to fight a harder battle at the local level to raise the funds.

How far should a youngster be required to walk, or how far can you walk them to get a school bus? It should be defined by law or by regulation.

Kentucky almost passed a law a number of years ago that said, "No more than three school bus stops per mile." It didn't pass. Some states have pushed very strongly to regulate to hold down the number of bus stops. Well, they have not successfully proven to me that eliminating bus stops is really fuel efficient. If i have to walk 30 kids to a location, and the bus sits there and idles while we are collecting them and while they are getting on the bus, we are burning up the same amount of gas it would take to make an extra stop to more efficiently get them on the bus.

We have not thought a lot of these problems through throughly. All we do is sit back and look at the situation and say, "It is going to go away" or "Somebody else is going to solve it" or "There has to be an obvious answer." But, my friends, the dilemma is on us. We will have spot shortages. We know the prices are going to be outrageous, and it costs money to operate those big monsters, a lot of money, not only fuel but everything else. Contractors are getting out of the business because of these operational costs and because it is tough to find drivers and pay them what they need to drive a bus. School boards are now looking for contractors to take over, because the fringe benefits are eating up the money and they can't afford to employ people to do the job anymore. So we have to live with this cost thing, and fuel is going to be a big impact on cost. It is going to be one of those uncontrollable things to a great extent.

Let's start with a state legislative body, a group whose laws or regulations

help us set up guidelines, limits and help us define the amount of service that we really are responsible for out here. Then let's realistically reimburse to that level.

Then let's go to the local school board, which is also a policy body, and then we get into the feasibility study. Who is eligible to ride? Grade level, distance factors are considered. Then somebody throws in a real cute expression: "How about hazardous walking area?" Somebody define "hazardous walking" for me. If I am a parent and that is my kid out on the road that is hazardous walking. Or is it just hazardous in the winter time? And all the other variables and factors that come into this service.

Hey, I think in the local district there's a lot of things we could do as far as sidewalks, getting community help with that, not only to build the sidewalks but see that they are cleared in the wintertime so kids can walk on them and not have to walk out in the street if the snow is heaped on the sidewalk. We're involving manpower and more money here, but we're talking about cutting down on transportation realistically. Districts are doing this in some areas and it is working very successfully.

Building organization. You have a K through 3 school here, and elementary here and a junior high and a high school there and a vocational unit here, and I have got special units here for handicapped, et cetera, et cetera. Everytime we organize or structure our district along these organizational lines and building lines, what are we saying? More logistics, more transportation. If all K through 3 kids are in one building, you must cover the whole district to get them to that building. Now we get into internal shuttles, transfers, and these are monsters and they are inefficient. They eat up fuel. Any type of internal shuttling or deadheading is fuel inefficient.

At one time I would have argued with anyone in this room that transportation should never dictate anything that affects our educational program. It should always support every objective. But we're reaching a point now where we have to take a hard look at the practicability of that theory and that idea. Transportation is something we need to make our district work properly.

The first thing I do when I do a management study for a district is ask the people, "Hey, is transportation really necessary?" If they say, "No," that's the end of the project. I can go home.

We ought to ask ourselves, "Is this school transportation really necessary? When is it necessary?

I'm going to throw you a curve ball in a minute. So far all I have implied is that we cut back by defining structuring and time. There are building

administrators who will sit and argue with you: "We've got six elementary schools and two middle schools in our district and one high school. We want all of the elementary schools to start and dismiss at the same time; absolutely no deviation." And the superintendent says, "Yes, that's a good idea," if he is waiting a couple of years to retire and he doesn't want to stir up the water any. I'm not really sure the people want that. I'm not sure that a 15 or 20 minute or even a half hour difference in schedule that would permit greater utilization of buses and reduce the number of units couldn't be sold to a group if it wasn't unreasonable. These are the things we're going to have to say, "Hey, folks, let's reconsider each of these points."

Through this whole feasibility approach, this management approach, I've got 350 questions involved at all different levels of administration and supervisors and drivers and mechanics and so forth to get some of the answers here. I want to know the superintendent's philosophy. Boy, that's dangerous. When you ask a school man his philosophy, you better be prepared to listen for awhile, unless he thinks you're trying to give him a trick question, then he won't respond at all. What's your philosophy on support services like transportation? What role should it play, and what are your objectives for your transportation system? You know what I am trying to do? I'm trying to focus attention on our problem. This is something we're not doing successfully. We're not getting enough people thinking about this.

We go from the superintendent now and usually to the business manager or the clerk treasurer or some fiscal agent. We start asking them questions along the line of "How do you know from week to week and month to month how efficiently your system is operating?"

Do we have the records to document the fuel efficiency of every bus in the fleet? I've seen some good ones, but most people do not. And if there is a change in the miles per gallon that's not related to a change in seasons, does our maintenance shop pick that up and tune-up that engine? Do we know the practical time, the real time to tune that engine up? I'm talking to the business manager now. What documents does he have in front of him on a regular reported basis to help let the board or the superintendent make good management decisions based on things that are changing or things that are not going the way they should be going? This is critical, and this is something I find sorely lacking across the country: Good documentation, good record systems in transportation. If you don't have records on the cost you're out of the ball park, and I don't mean deficit budgets all the time or transferring of funds. I mean being able to plan an annual budget realistically. What changes can we make in transportation services, training, procedures, equipment, or how we're maintaining the vehicles? When I say, "savings,"

I can go right back and trace every one of these things back to you and say "fuel savings." The amount of transportation I offer is going to directly relate to the amount of fuel I'm going to use. Cost and so forth are all interrelated.

I want the businessman to be able to project. I want him to be able to go back 4 to 5 years in actual operational records. The best cost comparisons and projections you have are within your own system. It's all right to average it out and compare it to state averages or regional averages or similar district averages; these are fine. But I want to go back to 1972 and '73 at the last fuel embargo and see the impact the energy curtailment had, and then the price started to climb back there, and be able to project that on a cost per pupil or cost per mile or cost per vehicle or cost per assigned vehicle or total cost or operational cost. I want all the analysis capability there -- that's the tool you have to work with -- and then show those costs projected from '72, '73, '74 right upt to '79 and be able to say to your board, "If the present trend continues, if all operational thigns continue the way they are here, here is where we are going to be in '80, '81, '82, '83, '84.

Now, here's a real tool to help make some decisions. All of a sudden in my chart and my flow, I see a downtrend. I go back to my board minutes and find out what causes that to happen. Did we reduce service? Did we go to all diesel engines? What happened to reflect that savings? And use that as a key for management decisions.

Now I leave the central office after I have talked to the fiscal officer and the superintendent and looked at the board policy, looked at the insurance polich, which we don't talk too much about here today, and get out into the opertional areas. I talk to that supervisor; he is the key. He's the guy that has not had the advantage in most cases of a lot of formalized education. He is not an engineer. He is not an industrial manager. He was a school bus driver. Maybe before that he worked in a service station; nothing wrong with that. The guy has come up the hard way. Maybe he ran a paper route and owned a farm and he was a little smarter than the average guy, and he was at the right at the right time and now he is supervising it; Running 35, 40, 50 buses. He gets along with people well or fights with them like cats and dogs; they are all human beings.

He has a garage he operates. He has a head mechanic and two assistants or one assistant and maybe a helper. He has some people in there who he has to show how to find the front door, and they afe usually underfoot and doing more harm than they are good. I'm talking about a typical cross section of what is happening.

He has a fleet of buses that sometimes will go back 10, 11, 12, 13, 14 years. In Ohio we haven't been able to replace buses to keep up with the ten-year rotation.

Well, are old buses necessarily inefficient buses, fuel wise? No, not necessarily, because it depends on the engine, it depends on the amount of work you give them, the condition they are in, the driver and the maintenance program. There are many ways available to us if we take time to analyze them and put them into practice and have everybody pull together.

Well, the supervisor has his hands full. If he has got 40 drivers, if he spent five mintues today talking to every driver, well, there goes his day. One of the things I find unfortunately is an awful lot of our supervisors don't know how to manage their time. Even if we gave them 300 ways to save energy they couldn't implement them.

We have more than a simplistic program ahead of us. We really must educate people. I think it's an education for survival, I really do. We have many districts that are in a dollar dilemma right now. I don't see a lot of people rushing forward with programs on any government level to stop this.

You go to one state that has had some problems passing issues and levies, and another where the state legislature does everything and they are sitting on the money and won't release it. State by state, different problems, fiscal problems. But good management of transportation is what we're after. Again, it has to be a collective effort with all people, and not only in the transportation program, school transportation program, but their own transportation program.

When Sputnik went into the air, I was teaching in a science class in an elementary junior high school. I had gone to our board the month before and said, "I really could use about 80 bucks for some lab equipment." And they said, "Well, we're going to have to put it off. We don't have the money right now. We don't get it out of our budget." Eighty dollars at that time was quite a bit of money. Then within the next 30 days the Russians sent their satellite up. And the next board meeting I had $300 to spend on science equipment. That's the logic. That's the type of thinking that we have if you could as a science teacher prove that you have a couple of bright kids who are going to solve the energy problem, you wouldn't have any problem getting money. But it is not quite that easy.

If we get past the supervisor, who is responsible for maintenance, driver selection and training, vehicle specifications, general condition of the fleet, carrying on day-to-day operations and so forth, we could spend another three hours just talking about all the different things and knowledge that he should have that can contribute toward energy conservation. He has to be a pretty sharp cookie.

Let's get down to some drivers now. Everybody will say to you when you talk to them "Well, the driver is the key to the whole thing. They can save you a

lot of energy and fuel."

Well, recently I developed a little energy evaluator. I'm just going to review its purposes with you.

In the first place, all of the responses, all of the answers we asked the drivers to give on here should be "Yes" answers, because the purpose is really to train or educate that driver in good driving skill habits and explain to him in the back part of this thing what those are, and also indicate to the supervisor who gives the test, "Boy, here are some people who need some retraining." And to design a retraining package, an in-service package, then to accomplish that, and then stay on top of it.

The first phase is to test an attitude. I had an attitude evaluation document or documents for a school board. Questions: "Do you think there is a real energy shortage? Or do you think the energy shortage was a contrivance to raise prices? Do you think governmental regulations are too restrictive against oil producers and oil refiners?" and so forth and so on. From their reading, from their media exposure, from their talking to other people -- the guy who delivers the oil to the local service station man or the guy at the gas station who has an opinion about everything -- What kind of an attitude have you developed? Because all of the exposure influences how you think.

So what makes up this attitude? I have never met so many experts since I have been asking people about energy. Everybody knows the answer. Please, I want you if you are not already doing it to develop a very skeptical attitude about everything you read and hear on energy and start logically putting together some things that now lead to what you should do in your life and what we can do collectively and the people that are around us and with us to solve this problem.

So the 15 or 16 attitude questions to the bus drivers just pursue that same approach. What do you really think about this thing? Do you think we've seen the end of prices? When I asked this question about three years ago -- "Do you think there is a real energy shortage?" -- 85 percent of the response was "No." Today, it has almost turned around. What has made the difference? The things that have happened around us and the media exposure and what everybody is telling us. Yet, my friends, when you get out there to find the real expert in this field there aren't any.

Now we're getting desperate. Now we're getting so negative about this thing that we worry we're going to run out of fuel, and this isn't true. You may run out of money but you are not going to run out of fuel. If you have the money you're going to be able to get it. That doesn't mean that we shouldn't make every

effort to conserve it and not waste it. That's the logic that we have to sell people and convince them because it is a true logic. Nobody wants to waste anything.

I don't think we're going to have to give up family days and vacations and things like this. I think we can save a lot of energy that doesn't even compare with the pittance that we use for things like that. Collectively, across the nation, it is quite an amount. But it is nothing to what we waste through the week in many cases: Running to the store to get a loaf of bread in the car, and then you get there and find out that the bread is 90 cents a loaf. It makes you go home a little slower. So that's the age we live in. All the prices are interrelated and all of them are affected.

The next thing I want to do in our energy evaluator is to see the driving skills of each driver. We have several driver trainers in the room here, and you fellows may agree with me or may not. We don't spend enough time on real skills. We have a braking system in our state standards. Each bus has a backup system or reserve system. If the primary system runs out of air, you have a third tank that is independent in there that would give you enough air to stop the bus so many times in an emergency situation. You had to push a valve to release the air and so forth. Manufacturers came out with several types of valves. And you would go around the various districts and say to the driver, "What is that valve in there for?" And they would say, "Well, I don't know, but when a red light comes on the mechanic says to leave the thing alone."

Automatic transmissions came out. There was a feeling for a long time that you can't use an automatic transmission to downshift a school bus. Still a lot of people feel that way, but you can downshift with an automatic transmission. We're not keeping up. We're not keeping our drivers really trained in skills. Every driver should be equipped to drive any other bus in the fleet, but look at the practice we have of hiring substitute drivers. All we're looking for is a body who is licensed that we can stick on there to get the job done. None of these things are being given a second thought; just so they are safe and don't hurt anybody and bring the bus back in one piece.

Every school bus is different. If you have forty of them and eight came down the assembly line one right after the other they are all different vehicles in their characteristics, their operation, the way the brakes feel, the way the steering works. You have to train drivers to perceive the differences on these buses, if they want to be energy efficient. Proper downshifting, proper shifting as far as the rpm is concerned. Going around the curve in a road can be energy efficient or inefficient. If you are going so fast that the centrifugal force is pushing you

away from the center line, you have to slow down, apply the brake and put the accelerator back on, you're wasting energy. Teach them to take the curve in one even turn.

Driver skills. The evaluator is designed hopefully to call ones skills to attention. Even if people say "Yes" to all of the answers it has made them think about the problem, and that's what we're trying to do: Focus their attention on the problem of driving a bus.

The last phase of the evaluator is to pick up those areas that we've asked them in the skill area, and we'll put together for them some of these questions that are designed strictly for driver skills, some of them are designed for maintenance. How do you report the defect on your bus? How do you follow through on it to see that it is done? Do you put it in writing?

There is also too commonly a prevailing feeling from mechanics that lady drivers don't know how to find the front end of the bus from the rear, especially when they say there is something wrong with the bus. We've got to dispel this. We have to do away with this. There is no difference in skill capabilities here.

Know the place of equipment, teach the drivers how to use their other senses other than just shifting and so forth, the senses of smell and sight and hearing everything to detect defects on that bus.

I can prove to you that if a bus is out of service the downtime is costly to you, because in most cases we are using a substitute bus that shouldn't be on the road and is very inefficient energy-wise.

Take your hills and your terrain into consideration, your traffic areas, your urban areas. It costs you more to run a bus on city streets than it does a rural area because of the traffic and intersections and lots of other things including more idling time.

I want to go back before I forget and just comment a little bit on diesel engines.

Diesel manufacturers will build anything we want them to if we are willing to pay for it and show them a market for it. They are, in their technology, only limited to market demands. There is a lot of competition out there. If 18 percent of that market is going to be divided between three or four manufacturers you better believe there is competition out there.

The drivers are very important. I'm not saying they are the only key to energy conservation of the school district, but it is important to talk to drivers because they will tell you also, "Hey, I drive my bus across the district with four kids on board."

I did a management study in Colorado last year. Eighty-six buses and half

of them were used in their handicapped transportation with relatively few kids -- four, five or six kids. They had a class size policy. Any class that had over 25 kids in it had to be transported to another school, and they had buses running all over that district all day long with four or five kids on board. So see, there is an awful lot we can be thinking about, different ways to do this type of thing.

Most boards are very sensitive to the demands of the community. Most administrators are very sensitive to board directions. So we've got another problem in education here. We're going to have to start educating the community, if you want greater fuel efficiency in our school bus fleet. Realistically, this is the type of service or level of service you can expect. Anything beyond that is going to cost you more fuel and more dollars. We're not doing that. We've extended services out here so far beyond the state minimum requirements, when you start cutting back you're in hot water immediately.

Well, let's talk about cutting back. Here we sit on 330,000 yellow buses out here that run almost every road in the country. We run buses where a respectable truck driver would never take a truck, a 16-wheeler. These buses go down these two-lane roads with their right rear dual hanging off the road most of the time, and the loads on the buses are all unequally distributed. We don't weigh kids as they get on the bus. Sometimes they run down the road sidways. I'm just trying to show you folks there are hundreds of ways to save energy and efficiently if we put our heads to it and our hearts to it. It is going to take both of those.

There are just a couple of items that I would be sure to emphasize with you. Public Law 94142 makes it mandatory in every school district in the United States to transport handicapped pupils that are identified as having special problems, to give all supportive services, which includes transportation. They only spell it out, they only mention the word two or three times in the entire law, but it is right there and implied -- not really implied but required that they be transported from ages two and three preschool, up through 21.

Generally, an evaluation team comes in after they find the person with the special problem and then they determine where that person can receive the most educational benefits, and that means transportation. I don't think many people object to that. But the problem is that we are spending 12 times, 10 to 12 times the amount of money to do this as we are for the "normal" transportation. We're going to have to rethink in this field too. We know if we move the special unit closer to the youngsters who need the help, the people who need the help, we have to transport them.

I have found some surveys showing youngsters on buses two and a half hours each way. All that's going to lead to is a lawsuit. I found youngsters who live

five minutes from home buses for one hour. Some even have to be gotten out of class early to accomodate transportation. That's wrong because we're trying to mix that type of service in with the regular transportation. They have to transfer and shuttle and lay over and all the different things like that.

One youngster lived five minutes from home, but they got her out of her therapeutic class, which she needed because she was orthopedically handicapped. So they had to cut it out so she could get on a school bus.

I have found single children in 66-passenger school buses traveling 35 miles each way, costing the board $20,000 a year. They asked me to come in and give them a solution and I did. I got a contractor to bid a small van on the thing for $12,000, and they finally woke up and said, "Well, if he can do it for 12, we can do it for less than that." I said, "That's what I have been trying to tell you."

We have to find time to address ourselves to these problems and do something about them.

I wish I could wave a magic wand and say, "Here are one or two big, simple solutions that will eradicate this problem and solve our money dilemma and our energy conservation effort." That's not where it is. It is these multitude of little things.

I'm going to throw some other ideas out here in a few minutes that I want you to give some consideration to. Hopefully, this meeting will help accomplish these goals.

Now, let's talk about trips taken with buses other than to and from school. I'm talking about extracurricular trips and co-curricular trips. Those are good terms; I think we ought to use it. Co-curricular meaning it is part of the classroom activity, and extracurricular meaning it is athletic or some other type of trip in nature.

We do an awful lot by studying the internal structure of these trips and scheduling structure of these trips. We can fill the buses up. I have talked to drivers and supervisors. We get 35 kids on a bus. a classroom of kids, we give them a brown bag lunch, take them down to the park. We eat lunch in the park where they can see the trees and hear the birds and put them back in the bus and take them back to school. That's silly, We've got to get across to our people, our principals and our superintendents, "Hey, let's screen worthwhile trips. Yes, let's use buses, because for every bus we have got on the road it replaces an awful lot of automobiles that would be out there in lieu of that bus." We found that out during the '72 and '73 embargo. Some people proposed then we cut back on buses. All we did was put cars on the road. We are a nation of two-car and three-car families,

so the cars are there.

We have to develop an ethic for energy conservation in this country based around school transportation on a community level type of effort. We have to see how we can utilize these buses, and many states have permissive legislation. Again, that bothers me. If it is not worth having a law then don't put it in there. But don't say, "You are permitted to do this to local people." It just puts a monkey on their back and they have to fight the battle.

What is feasible in using these yellow buses? They are not very comfortable for adults, especially senior citizens. So we ought to think about some redesign in future school buses. Something I'm working on now and feel extremely strong about is redesign of buses to transport handicapped kids. I like to use the term "kids with special problems." That's all they are. If we had a bus catch on fire with these children on board today, we're going to lose the kids, we can't get them off especially if we have some wheelchair children on there. That's ridiculous in the technological age we live in to send in 16 or 20 kids aboard one of these vehicles.

In this area we're not using our heads. We're not using the God-given ability we have to solve these problems. We need engineering help, and we need all the help we can get to get some of these things done.

Now, let's talk about the bus garage a little bit. To use an old expression that I have heard for years, quite often it depends on whose "ox is being gored." But that's human nature, that's what we have to live with and deal with.

Mechanics are a peculiar breed, so if I am "goring some oxes" here, ladies and gentlemen, forgive me, but all I know how to do is say it as it is. Most of the times they will fix things and if they can't fix it they will get the manual out and read it; you know, the "seat of the pants' type of operation. We're improving in this area rapidly, but we still have got a long way to go.

I love to get a group of mechanics, maintenance oriented people together and have a debate with them, have a friendly discussion. Hey, how often do you change the oil in that vehicle? Do you change it on a time interval of mileage interval? "Well, 3,000 miles or two months, whichever comes first."

Why do you change the oil at 3,000 miles? "Well, it is dirty, it is contaminated."

How do you know that? "Well, you can look at it and see."

See, we're a victim of petroleum engineers; we have been for years. The best preventative maintenance thing you can do is change the oil; it is the cheapest, easiest to do, really keeps the engine running topnotch. That's what people think.

Douglas Aircraft out in California runs about 8,000 vehicles of their own; Company cars, trucks, all this type of thing. Several years ago they decided to make a little study on some of this 'philosophy" of petroleum people about filters, oil, about spark plugs and other maintenance items. So they sealed the hoods of all of these vehicles, and only the engineers and supposedly the people working on the project had access to the engines. They wound up on an average of changing the oil every 15,000 miles, because oil doesn't wear out. So then they put a lot of additives in the oil to keep the acid from building up and keep the water down, and it gets black, it gets dirty looking, and that's heavy carbon. Isn't it ironic that the more heavy carbon you have, the better lubricating quality you have? It gets better until you reach the point of acid contamination or too much moisture buildup. There are ways of testing this oil to find out when that happens. You don't even have to send it away anymore. You've got oil analyzers you can buy and put right in you shop. How much do they cost, Jack?
(Comment from the audience): $240.

MR. COMBES: Two hundred forty dollars for a fleet of 40 or 50 buses. It wouldn't take long to pay for that, would it? By examining a drop of oil out of that engine you can tell what the contamination, the dielectric change in rate is and when to change the oil. Even the petroleum people will tell you. "Hey, I don't agree with that scale. Ours will go even longer." Things like that. Spark plugs, they ran two sets of plugs. They got about 90,000 miles on two sets of plugs, because they know a spark plug loses its efficiency as it corrodes on the ends and rounds off those electrodes. They found out by using a little finishing file and keeping them squared off that you can put the plugs right in and run them another 15 or 20,000 miles.

Air filters. Now, there is some controversy on this. I'm trying to find out some other information. But those people found out that the dirtier the filter became the more efficient it became, because you change the filter from a two micronite filter to a five micronite filter.

Now, all I'm suggesting is to reexamine your procedures and practices, do a little oil analysis. When that oil was 15 cents a quart, no problem. It runs a little higher than that now. We may be dumping hundreds of thousands of gallons of oil down the drain unnecessarily. We don't want to damage engines, but that's the skill you have to learn to do this job.

Engine tune-up. No question about it, fuel efficiency demands a properly tuned-up engine. But do your records support the time when the tune-up should take place? Do you have that kind of an ongoing program?

Well, a lot of the things I'm suggesting may take a lot of man-hours, but a lot of them do not. I know there are just so many hours in a day.

The maintenance facility. You can save a lot of energy, electrical energy, if you will, around these things. These are big, vast open areas. In opening and closing the door you simply let heat out, a factor in saving energy. Lights that aren't being used or any electrical apparatus that's not being used should be turned off, this saves energy. Does it save fuel? Yes. It may be burning oil to generate that electricity. That's why I am talking about a total effort here and not each one of us individually trying to run around and educate everybody else, but some collective programs by departments of energy and departments of education and school district organizations, school business officials' organization. We need a consorted, coordinated, onslaught here of information and programs and how to do it, and then set up a program to share information and programs and how to do it, and then set up a program to share information. Boy, what a desert oasis the school districts are when it comes to good ideas.

Let's create in our districts' this energy ethic that I am talking about by developing a reference library for our drivers and our mechanics. Hey, a lot of the popular magazines and publications and newspaper articles and things talk about this problem all the time. Let's encourage people to bring them together. Let's get the information centralized and in the driver's rooms and so forth. Let's encourage them to read this to become better educated in this area.

Our state organizations, our professional oranizations can be of great assistance in this area. They can offer to publish articles by drivers on how they save fuel. On the marquee you see out in front of a lot of high schools and school districts, let's get some things up there saying, "We saved 542 gallons of fuel lat month in our school buses." We have to build a public awareness, first a district awareness of all of our people. Let's bring in our manufacturers and our insurance people and use them as resource people. Let them see what is happening. These people with their broad exposure and experience can make contributions. We don't expect everyone to do everything the same way, obviously. But let's see what your game plan is.

How about routing buses? Well, routing buses utilizing equipment is probably, if I had to pick a major way to conserve energy, one of the ways it could be done. I have found in over 400 routing surveys that I have been involved with that unless you did a major rerouting in your school district in the last three years, it is time for another one, because the demands are always changing. There is always a shift in population, a decreasing enrollment, or an increasing enrollment, vocational transportation, class size transportation, field trips, all the other things that are continually on demand in the transportation fleet are definitely

the key to big savings.

The districts I have been directly involved with showed a savings potential of from 20 to 45 percent. I found none that could potentially save less than 20 percent and that's dollars, that's fuel, that's the whole ball of wax.

I think it's time that we take a look at our building organization that I referred to earlier, or reorganization, where we can place kids the most efficiently to reduce a necessity for transportation and then set about to reroute the buses, do some adjusting in school starting and dismissal times. We don't want to interfere with the length of the educational day at all. But we sure want to use some buses a few more miles rather than putting another unit on the road if we possibly can.

What are your potential savings? Well, in a couple of districts, we had 26 buses involved in transporting to three elementary sites and one junior high school, high school site; for three townships in the geographic area. But they were running all their kids into all their elementary schools and then shuttling all their kids into the junior high school, senior high school, handicapped, special school units and so forth.

We wound up taking out six buses; we could have taken out eight. And because of the internal shuttling and duplication that was going on from the time the first youngster was picked up and until the last one, we actually cut mileage and had a potential savings using their own cost information of $40,000 a year. Now, that's a tough decision sometimes for a board to make. You would think on the surface, "Boy, that's fantastic, that's great." The reason I mentioned this example is the board didn't buy any of it. Why? Well, they had six contract buses out of the 26, and the board policy said that any cuts that had to be made would first be made with the contractors. These were people that live in the community, they are nice folks, they have been there for years, so forth and so on, and they felt it was not politically compatible to do the job. This is part of the problem we are confronted with. If we get down to hard cases and bite the bullet, we can do a lot of savings. Of course, we want to be human, but that pointed decision has to be left up to local boards. We have to provide the tools and and the direction and the information. Several of them are thinking about it. I'm sure that as the contractor stays on they want to go with a couple of them next year. They are going to go into a modified program and planning for a full program of this type. So maybe you can't do it tomorrow, but six buses running the mileage they run is going to burn up a lot of gasoline in the next 24 months.

Specifications of buses: Another very important area that we can save energy in. We have a lot of technology here today that we don't use.

In 1971 a school bus went out of control on a mountain pass, ran down 14 miles of mountainside, crashed and killed and injured a lot of children. After that the supervisor, whom I visited a few months ago, said, "We'll do anything to keep this from happening again." So they equipped the buses with electric drive-line retarders. They have been used in Europe for four years in the Alps. There are eight electromagnets mounted around the drive shaft and a control switch that engages two of those at a time, a four position switch. He has buses in his fleet that have 80 and 90,000 miles on board and he has not touched the brakes since installing the retarders, extending brake life two and three and four times by actual test out in L.A. A $2,800 investment that can be taken off the drive shaft and put on another bus if you change buses. Saving brakes, does that save energy? You better believe it.

How many BTU's (British thermal units) are expended in manufacturing a ton of steel, or 1,020 tires, or all the glass that goes on a bus, or all the other components that goes on a bus? This is a lot of expenditure of energy, a lot of it generated by burning oil.

Do you see the connection here? We don't want to build a disconnected monster. All of this is interrelated. It's a total effort. School transportation people have a wonderful opportunity to lead the way, like we did after Sputnik. We can turn our schools again, and what a wonderful opportunity to show the community in a concerted effort that we are retraining, we are regearing, we're going to get the job done. But that's the challenge, I think, in this area.

Other specification factors. Let's quit buying buses bigger than we need. What is the utilization factor on your vehicles? How many kids per day does your bus account for? 2.5 routes or 3 routes in the morning account for 70 kids. That's not good utilization, and if that's a fairly common thing in the fleet, then you are due for a rescheduling or rerouting.

Get your utilization. Find out what your percentage factor is now and use that as a comparison figure of where you are going to be a year from now once you get your buses on the road. That's an indicator.

Maybe you don't need all 66-passenger buses. It used to be the reason you would buy them that way is because that was the cheapest that you could buy, but it is a heavier unit than a 48-passenger. It takes more energy to run it. You may be able to change the engine configuration to give you more efficiency. So take a look at your fleet balance. What do you really need as far as work demand?

Now you say, "Well, when are we going to put these 66's in? We still have an enrollment growth and we want to allow for growth." But in most of the parts of

the country now we are in an enrollment decline.

What I see in shopping centers now is an indication we're in for another growth factor. You'll see a lot of girls who are starting families right now. So you folks in the school business are safe for a few more years anyway.

The power train is not only that engine, it's a total power train configuration. Folks, remember, chassis manufacturers are not building school bus chassis. Chassis manufacturers are building trucks that can be modified to accomodate a school bus body.

One or two times in history we had a chassis that was specifically to transport kids. We don't have that. We hang frame rails on this thing and we hang a body on there and we call it a school bus. So the proper ratio, the proper engine, torque capacity, you don't need the same type of engine in the flat part of your state as you need in the hilly terrain. But we'll buy the big engines. Now, this has been messed up on in the last few years because with the pollution demands we have decreased the efficiency of the gasoline engine.

I'm not arguing against pollution demands. I'm saying the technical people should get busy and design us something better.

The type of tires that you operate can be a decided factor in fuel efficiency. Radial tires are giving us better fuel economy, mileage-wise and miles per gallon wise.

Rubber suspension systems, the More Ride Company. I can mention them because they are the only people building the thing. They had some problems in the earlier models on keeping the mountings on and things like that, but they got that worked out.

We still don't have the full facts yet, but I strongly suspect it's going to contribute to the life of a school bus because it absorbs road shock out of the drive line, the transmission, the axles, everything; absorbs road shock and makes the body last longer, and there we go back to how many BTU's it takes to manufacture a bus body. So it's an energy potential savings. There's literature here if you want it, if you are not familiar with it.

(Question from the audience): Has anyone done any serious testing of the design of the bus? THe old bus bodies were always kind of rounded. Now, they tend to be more square. Have they done any design testing in terms of wind resistance and so on?

MR COMBES: Not to my knowledge. But I know one thing, the square buses offer a lot more wind resistance than any other buses.

(Comment from the audience): That's one of the things I see in the literature.

MR COMBES: Some truck companies are using spoilers; they are going that

far, But I don't know of any other school buses, do you Jack?

MR. WILSTER: I saw an article that said some of the trucks are cab-over, more frontal area on them, and they found out they got as good a fuel mileage as the one with the convential nose on the front. That's all I know.

(Question from the audience): What is the possibility of propane as a fuel?

MR. COMBES: I wouldn't touch propane with a ten-foot pole for two reasons: Number one, it is more costly than gasoline. You can check with a gentleman in Atlanta who ran 45 propane buses and got some good mileage with them. But the big reason is propane is highly volatile type of fuel; it is awfully dangerous. Your're going to carry a 30-foot operator tank under the skirt of that bus. If you hit a spark it will blow you into the next county. Not only that, but if we do get into a true energy shortage, propane is one of the chief ingredients used in the production of vinyl, and the source is going to dry up in a hurry.

Now, the industry will tell you contrary to that, but those are the things that came out in '73 when they were trying to get us to use propane in Ohio and I did some checking and investigation. And as soon as the embargo hit you couldn't buy propane anywhere; it was all going to the vinyl manufacturer. Do you know how many things we use with vinyl? So the cost factors, the safety factors, which I would list firts, and the availability factor are primary.

(Comments from the audience): We had a couple of people at one of our meetings on propane, and right now I think the cost factor is reversed. Right not it's less than 50 cents a gallon. You're going to put about $1,200 to $1,500 per bus.

(Comments from the audience): No. 500.

MR. COMBES: Are there any other questions or comments at this point? How is our time holding up?

MR. DOERR: About 15 minutes over.

MR. COMBES: Thank you very much.

(applause)

MR. DOERR: Our next speaker is Mr. John Rankin from the Mainstem Corporation.

MR. RANKIN: Fleet management has been discussed quite a bit here with the focus on energy. We figure that a lot of energy is spent in a lot of ways, some of which has been pointed out already. We do not concentrate all of our effort on saving just fuel in your fleet. We concentrate on saving money via the garage, better driver training, and quite a few other aspects.

Sixty-five percent of our clients are in the public sector. They would be public utility companies, mass transit systems and extremely heavy involvement with

municipalities and bus fleets.

Some of the goals that we have: Finding vehicles that are disastrous as far as fuel goes, pinpoint that one vehicle, find out why that vehicle obtains poor mileage, and then you can take the proper steps to correct it.

Our competition is a distant second place. We have the unique ability to provide a fleet advisor to you. So we don't leave you alone with our reports. We call on you on a regular basis to analyze your fleet, present additional opportunities to save money or overhaul your fleet to bring it up to better standards, or try to arrive at goals that you would set for yourself or that are mandated upon you.

It is a complete first analysis system. It sets up preventive maintenance programs so that you can have the vehicles on the road, you run the fleet instead of having it run you and come in whenever it breaks down.

Through very limited input from you we can provide all the information that we have or that we'll be showing here.

This first report is a 1,000 Report; that's just the number assigned to it. It gives you a breakdown monthly of each one of your garage activities. It helps you you to provide budgeting; it compares that with the actual for the month, plus we have a column for hours and dollars for what was reported to us, so that we can compare it with what the accountants say you did. About 95 percent of our input comes through repair orders. If you are not using any repair order right not, you probably should be using some version of a repair order.

We will give you a percentage figure that tells you what percentage the reported is with the actual that happened for the month, and then to find out if you have any ongoing trends, we give you an average for the last three periods or months.

(Next Report): This second report is an anlysis of all the indirect labor occuring in the shop. Altogether there are about 250 different categories that you could assign indirect labor to. You can select the one that best suits your needs.

You can find out what the current period is, and then you can go back to various periods and find out "Do we have an ongoing trend in indirect labor?"

By reducing indirect labor you are putting the guy on the job more often, which cuts down your fully burdened labor rate.

(Next Report): This is an analysis of everything that occurred in the shop, and it is very summarized information. It tells you how many scheduled repairs, nonscheduled, road calls we had and by cause of repair, normal wear and tear.

accident, capitalization and statutory, and then the total.

You can find out how many hours the average nonscheduled repair took versus the scheduled repair.

We can find out the average number of dollars for that repair and compare that to scheduled repairs that you would be doing as far as preventive maintenance would go. So you would find out how much it would cost to not have a PM Program.

(Next Report): This is an analysis of everything that occurred in the shop by repair type. On the left-hand column you see all the various repair types that we capture. And then we can look at units repaired, how many repair orders there were for that category, repair orders per unit. This can give you a breakdown -- for example, this subtotal right here for the power plant, we had 697 vehicles in for repair and 1,200 repair orders, giving us pretty excessive repairs. Eight out of ten vehicles had to come back and be fixed for the same thing, which keeps them off the street and out of service. This may tell you that your mechanics need additional training, because they aren't tuning the vehicle properly so it's not getting correct mileage. And then after it still misses it comes back in and they do a complete tune-up.

Going across the top we have the total number of dollars for repairs for the different categories: Commerical dollars, parts, labor dollars, labor hours, whether the repairs are scheduled, nonscheduled, and then the cause of repair also. One of these will be prepared monthly for each one of your garages.

(The next report): Gives you an analysis of vehicles assigned to different divisions. If your fleet is broken down by districts or by the different schools, we can give you a summary of the cost for each one of those school districts so you can come up with the one is the most expensive, how much to bill to that district so that we don't have to subsidize the operations of the school district with your garage. The garage should at least break even.

(Next Report): This is a summary of a fairly large operation giving the same type of totals as the previous report except it lists just one line for each one of the various garages. And down at the bottom is a total for the entire organization.

(Next Report): This report is a breakdown of all the vehicles that this client has, plus it's broken down by vehicle type. Like vehicles are put into the same categories, then you can directly compare the two classes to find out if we shouldn't buy a certain type of vehicle anymore because it is too expensive. Those are just examples.

If we find out it is a bad one, why is it bad? If we look here, we have

five station wagons accumulating 6,400 miles per month using 532 gallons of fuel for that month for 12 miles per gallon. There are five units all operating, four of which were repaired. So we can compare that with this other category, and this one is suffering a little bit on fuel economy. This one right now would be the better choice.

(Next Report): To dig into this information even further, we take all those same class categories and look at every vehicle that's in that category and find out if that class is as good because of one or two vehicles that are expectionally good or possibly aren't reporting all of their fuel. We can go straight to this and pick out the high cost per mile units.

So looking further at this report, we have the current period right through here, maintenance costs, operating costs, usage per vehicle, miles per gallon for each one of the vehicles per month. This column right here is miles per quart of add oil, so you can find out for instance if it is a diesel, and it is starting to burn more oil, then you know you are going to have to take some action to keep from replacing the whole motor.

If it is going okay for this particular month, let's find out what happened the last 12 months. So we just look at the same type information provided to you for the whole 12 months. And out here we can look at total life costs, and on the right cost per mile and cost per engine hour for the entire life of the vehicle.

(Next Report): This is a 136 Report. It is an exception report that is keyed to various parameters that we would set up with you. The vehicle is listed with its name. Out to the left is a class code. This is the equipment number and number of work orders for the current period and the cost for the work order for the current period.

If you are interested in finding out if the vehicle is in the garage more than two miles a month, or accumulating more than $500 per month, then these would be the parameters. If it is in there three times or $501, whichever, it will pop out and print a line for you and say, "Take a look at this vehicle because it passed the parameters that you set for it."

For road calls, we have current period and previous two periods. You can put parameters in here so you can find out whenever you have a vehicle that has excessive road calls or exceeds the number of road calls that you think is sufficient in one period.

Then we move to damage costs. You might want to set that at zero. If there is any kind of damage to the vehicle whatsoever, you may want to know about it right away. If there is $1.00 worth of repair, it's going to print out on the

sheet. Moving to accident, whenever there is any kind of accident, you would want to know about that so you can check with your internal system to find out if you had an accident report or take necessary actions with the driver.

From there we would go into preventive maintenance and we have four different types. The first is lube, and it can be based on months or miles, the same as the auto manufacturers do with their warranty. If a vehicle should be lubed every three months or 3,000 miles, we would set parameters of 2 and 3,000 miles here. Then in the third month you would have a list, just go down this column to find out what vehicles you have to bring in the shop and do a lube on them. If it accumulates 3,000 miles in the first month then it is going to pop out for that reason. The same for preventive maintenance A, B and C. Those all can be set independently of each other and it will kick out for whichever is the reason, if it is months or usages. A lot of people will use PMC for an annual inspection or something like that.

Out to the right the computer can tell you which vehicles were down too much or too little. Usage is a double parameter for that one. You can set over-usage and under-usage. So if a vehicle is not driven enough it will pop out and tell you it hasn't been used enough, and again for excessive usage. If it exceeds the miles you think are too much for a vehicle in a given period then it will pop out for that reason, then you could possibly rotate your fleet.

(Next Report): This 111 report is also geared to parameters and is also annually for everything. It is a summary of everything that has happened to each vehicle ever since it has been on the Mainstem System.

From here to the left is everything that happened in the current month. Then it goes to the previous twelve periods and also life information.

Out at the right here, if it is kicked out for exceeding parameters a star will appear, telling you why this particular vehicle popped out.

We would also print this for you once a year for all of your fleet. We're not in the business of selling file cabinets. And eventually you will want to throw away all of these old repair orders, thousands of them, and replace them with one sheet. Every year we give you a new sheet so you don't have to save all the old ones.

(Next Report): This report is a summary of the entire class. Now, say, if this were a 60-passenger International bus, this would be the only vehicle of that type. So you could look at this report and find out, "It is a good thing to have this type vehicle, but let's see if we can spec it any better." So we go through the various repair times and find the high cost areas so we know, "Well, why is that a high cost? Is the fuel system always failing?"

This next report is very good for specing new vehicles that you are going to buy.

This portion of it is a breakdown by the various months of the vehicle telling you what the costs were for the fleet as it gets older. Down here we have day one when the vehicle was new. You can see that the usage keeps going up, also the size of the fleet keeps going up. Here is usage per gallon, usage per quart of add oil; number or vehicles, usage per vehicle, maintenance costs, net costs per mile, warranty recovery, anything you managed to get back from the manufacturer.

A lot of the manufacturers will go by the information that we provide because they know it is good information, and a lot of people will get money back for repairs that they have had to make that should have been covered by a warranty even though the warranty had already expired.

This column is downtimes. The first month for these vehicles, it was 70 and now it is up to 1,879 downtime hours per month for the whole fleet.

Out to the right we have "accident" and "capitalization and statutory." We like to keep those separate because they cannot really be controlled by the garage. Capitalization is something that is required by superiors or is required to put the vehicle in to service, maybe adding lights, radios, something along those lines. Statutory would be something that's required by law, which we're all familiar with!

(Next Report): Continuing with the same class of vehicles, we break all the information down by mileage intervals or usage intervals so that we can find out when the vehicle starts to get bad. Where in its life does that occur? Is it 30 to 40,000, 40 to 50? Then we also provide it by repair type so we can spec only one part of the vehicle a little bit better or we can say, "In this vehicle the engine should go away at 45,000 miles or 50,000 or a hundred thousand miles, something like that."

All of the information across the top is adjustable. So if you want to make parameters that are 100 or 200,000 miles you can do that. On this vehicle, the engine is supposed to go at 45,000 miles, you may want to sell it at 40 so that you can get a better resale from it, or you may want to look at the records and possibly find out that you already put the new motor in, so let's hang onto it for another year.

(Next Report): Our inventory is set up so that you can have complete leeway of what you want in the inventory. All we really need in it is the vehicle I.D. number, the year, the make and what type of fuel it has. The vehicle number is here, the year, the type of fuel, the manufacturer and what type the vehicle is. Everything else is set up for assigning the vehicle to different divisions or

different departments.

(Next Report): The next to the last page of the inventory lists all of the different classes of vehicles that you have. Those are broken down so that they are like vehicles. For instance, your 60-passenger bus that's an International with the Detroit Allison motor in it, that would be a unique class. Another class would have a Cummins motor in it. Thy you could directly compare similar vehicles with one exception. They you will find out if you should buy the Detroit Allison, or get the ones with the Cummins in it.

(Next Report): This is a summary of what has happened in each one of the garage. I know a lot of you don't have that many garages; not many of our clients have that many garages. Most of our clients work out of one main garage and have a fleet of maybe 50 or a hundred units and up.

(Next Report): This is a fuel report by fuel site and by type of fuel at that location. So it will analyze what your opening inventory was, what your receipts were what you dispersed, and hopefully we'll come up with the same number that's on the stick at the end of the month. "None was stolen." Fuel is getting expensive now, so it is worth stealing. It's good to have some report that will tell you what you should have in the ground, and then you have our other reports that will tell you which vehicles are using the fuel and at what rate.

(Next Report): This is a leasing billing report so that you can bill various operating divisions for equipment that you leased to them. This would be valuable in a stituation where, say, the garage owns all of the fleet and leases it to the operating division.

We have billing reports that range from even more sophisticated than this that would have, so much per mile or a base rate like a rental car, so much per day plus so much per mile, and maybe even give you the first hundred miles free plus you can bill divisions for the accident and damage, all the way down to the simple ones that will tell you what happened for that division and give you a total number so that you can bill them for the repairs that have occurred.

(Next Report): This is a summary of the cost of ownership, listing each one of the vehicles, usage, maintenance cost, operating costs, cents per mile for operating the vehicle, depreciation, license, tax, and total cost. You can see again that we add in accident cost at the end because again it is not controllable by the garage.

To look at the input that we need to generate all of these reports. The one at the bottom here is an indirect labor sheet, the means for you to supply the indirect labor to us. The one above is one of the many ways we can capture fuel. It is similar to a gas station credit card and its machine except it doesn't record

dollars, it records gallons of fuel and quarts of oil. We can also pick this up from a log sheet. If you have an automated gas system we could possibly capture fuel from it.

(Next slide): Lastly, this is a copy of our repair work. The top section here is imprinted with an imprinter, which also prints the vehicle name.

Here you select the class of repair, whether it is scheduled, nonscheduled or road call. In the next section is a list of the causes, normal wear and tear, warrantly, damage, accidents, and then combination class/cause repairs would be capitalization and statutory.

When the vehicle comes in the repair order is stamped. Two of these boxes are checked by the service-writer, or the foreman. If you have any outside repairs, you can put totals here, or you can submit it to us later if it takes a while to get an invoice for reparis. There is also a space for out-of-service time and back-to-service time and then a space for downtime. It is one of the preventive maintenance repairs, you can insert the mileage. This also satisfies the previous reports that we saw that had mileage intervals for PM Programs.

Down on the left-hand side is hours and minutes of repair and repair types. which are taken from the right-hand side of the repair order. And then there's a space here for parts used in the repair, and those are also listed by repair type. We aren't looking for all the part numbers or anything like that. All we need is total dollar amount.

When the vehicle comes in you write the problem here, and there's a space for a mechanic to write in what he did to the vehicle. All of our repair orders line up with the vehicle history jack so you can make a little "X" to find out during the month if you are repairing the same thing twice to the same vehicle, if you happen to make that repair before our next set of reports come out.

A lot of people do not have any type of management information system. Fleets are expensive enough now that you have to have something, whether it be ours, something you invent yourself or if you get some help from a university to invent one. Some of our competition have good systems that have been copied from ours. They have to be good, they are about the same as ours. However, they do not have a fleet advisor. That's what makes us unique. Our advisor becomes a part of your team to come in and read the reports with you. You don't have to spend a lot of time digging through them. He will also train you so that you can dig through them, and you can just give him a call on the phone at anytime.

We have fleet advisors all over the country so there would be no problem in servicing you at any location. Most of our clients are called on once per month or every six weeks, something like that. You never end seeing him.

Are there any questions about Mainstem or about any management information systems?

It's kind of tough to make decisions about your fleet without some type of input. We think we have a pretty good system. A lot of people have some pretty good systems. A lot of people have some pretty good systems that are available to help you make these decisions. It's pretty difficult to pick between the two bottom lines if you don't know what they are.

We can summarize for you what it will cost to not have a brake lathe. If you buy the brake lathe, how soon will it be paid for? The same thing for a scope, like an analysis scope.

Normally we save you money through cost avoidance and helping you to pick the best way to spend the money you have. We also help with elimination of repetitive repairs to the fleet, whether it be more shop equipment, better work in your garage, better mechanic training, or better specing of the fleet itself.

When you go to retire a fleet the reports will tell you which vehicles to retire, you don't have to make a quess! It's not necessarily the oldest vehicle that should be replaced. Very possibly one that's only two years old could be the real "lemon" and is the one that should be retired.

Some people that are in the business of leasing equipment to some of the big manufacturers use our system to assist the manufacturer in buying out of leases for vehicles that are newer and in fixing up the old ones because they are cheaper to operate.

MR. MYATT: Can you tailor that to specific area, or do you have to get the whole shot?

MR. RANKIN: 'The reports that I have shown you are the basic report package that we have. Altogether there are 65 or 70 different reports, and each one of them is in a different format. There are different formats of the same reports so that you can select the ones that are best suited to your needs. You don't have to take a cut-and-dried fixed or canned package; we're not in that kind of business. We can't tell you how to do business. We have to supply a report that is in a usable format with the kind of information that you require.

We have an advanced system, also that was mentioned, that is a complete on-line system that gives you instant access through CRT terminals. You just walk up to the box, ask it a question and it gives you the answer. Not only does it give you all of this same type of information on the fleet, but it gives you information daily, plus the complete parts control inventory system will tell you where to buy the parts, who you are waiting on parts from, what parts were back ordered, what you received in parts, and if the vendor can't supply it to you, who is your alternate

supply source. It will tell you what bin to go to to get the part; it will do just about everything except bolt it on. It will tell you who bolts on the parts good and who does a bad job of it. It will tell you who is walking around drinking coffee and smoking cigarettes when they should be tuning up the vehicle. So it touches on the employees, the parts and the vehicles.

MR. DOERR: John, is there a threshold in the number of vehicles where this becomes more economical?

MR. RANKIN: It will pay for itself no matter if you do operate a small fleet. Our smallest fleet is 49 units.

If you have 25 or 50 vehicles minimum, the system will more than pay for itself. Our largest customer, I think, is 13,500 units.

There are a lot of different reasons why clients want the information. Some people just want to say, "Yes, I have got a system. It is setting over there in the corner." They are the ones that don't save any money with it. Some others use us only so they can have a complete inventory of their fleet. I talked to a city last month that doesn't even know how many vehicles they have. They have been able to pin it down to 7,000 plus or minus 1,000.

Any municipality or public organization has, I guess, a renewed awareness of accountability, and has to be able to account for everything.

We give you the ability to account for anything and everything and only require a very simple method of just giving you a repair order and a fuel ticket.

MR. DOERR: Today, our first presentation will be given by Larry Louderback of the Michigan Department of Education.

MR. LOUDERBACK: In the State of Michigan, we legislate the requirements of school bus driver education. However, at this time, we are working on a Federal project to modify those legislative requirements. In the State of Michigan, the school bus driver is required to attend safety education classes for twelve hours during each two-year period. It is a common practice for local school districts to direct the bus driver to attend a six-hour safety education program once each year. We suggest that any states considering legislating school bus driver education approach a mandated school bus driver program with caution. The material which is available for the bus driver is actually at a minimum. Unless care is taken in writing the law, the material becomes repetitious to the drivers year after year.

It is recommended that the beginning drivers be given a lengthly and in-depth safety driver education program, however. Experienced drivers receive a refresher course. Currently, we are working with a federal grant and we are in our third year of developing a modified type of driver education program. We are testing a new program for beginning bus drivers and a program of in-service training for experienced bus drivers through the intermediate school districts. In Michigan, the intermediate school district is like a county office. There are 83 counties in Michigan and we have 53 intermediate districts; some cover more than one county. There are usually transportation persons in the intermediate school district to assist the Department of Education. When presenting a full scale program, the Department of Education does not work with each of the local school districts, but through the intermediate school districts.

The Department of Education is really looking at overall energy conservation. We feel if every person does his/her part, we can improve energy conservation. I'm talking about everyone in the country, not just Michigan and school bus fleets. Up until last August, many of the school districts were probably doing little or nothing about energy conservation. The Department of Education sent a letter to the school districts suggesting some of the things that they could do to conserve energy. We know that they were aware of the energy crisis, but until recently they didn't really thing they would be running out of fuel. We had one school district that was ging to be 3,500 gallons of gasoline short to complete the school year and yesterday, Dr. O'Leary found two school districts in the Upper Peninsula that were already out of fuel. However, they were dry because the distributor was unable to obtain fuel from his source. The letter we sent out suggested that there be bus route modifications and that the children walk a little farther. It was

also suggested that there be a reduction of the field trips and control of the operation or idling time of the vehicles. The school boards seemed to be in favor of this and we have recommended that they reduce the number of bus stops. In Michigan, we reimburse the school districts for transportation of pupils who live one and one-half miles or more from the school which they are eligible to attend. We don't prohibit the school districts from transporting pupils who live closer, but the school districts aren't reimbursed for that expense.

Where transportation is provided, we expect elementary children to walk up to a half mile to a bus stop and secondary children are expected to walk up to a mile to the bus stop. Where the school districts modified bus routes, they were successful in reducing the number of buses in their fleet because they weren't driving the miles and pupils were walking farther to the bus stop. In many cases, the parents were beginning to realize that there are very few state laws that effect transportation and that the local school districts have authority in planning bus routes. We made up a package of the school code laws which affect transportation and we make it a practice to send it to parents who have questions. It is a very descriptive school code and states that children will have to walk a mile and one-half to school or walk a half mile to a bus stop for elementary children or one mile to a bus stop for secondary children. I would guess, right now, that ninety-nine percent of the school districts provide door-to-door transportation for kindergarten children. I think it is a worthwhile expenditure even though we don't reimburse for the pupils who live closer than 1 1/2 miles to the school which they are eligible to attend. We are getting some cooperation in the conservation program where parents allow it. We are getting some flak from some parents because of the reduced number of bus stops. Some of the bus routes are being changed back after they are modified because of local political pressure.

We are having a hard sell with bus drivers and energy conservation; asking them to turn the bus off when they arrive at a school or loading zone a few minutes before school is out. We have seen as many as thirty-five buses idling and drivers not in the bus. We are not only talking about winter weather, but warmer weather also. I am on the road quite a bit and when I see a school bus running while it is parked at a loading zone, I will ask the drivers why the bus is running. I was in one school district recently and there were twenty-seven buses in front of a school building sitting there idling. Two buses had their motors shut off. I went up to the drivers and asked why they had their motors shut off and in one case one of the children on the bus yelled out "We have the engine shut off because it saves gas." One of the other drivers said "Nobody told me not to shut it off," and another driver said her supervisor told her not to shut it off.

I quess I always thing about gasoline when we talk about energy conservation and we also know that repairing of parts, motor parts and replacement parts are all energy consuming activities. It takes energy to make parts. I quess when I think about conservation, I mostly think about conserving gasoline. I read the national average on fuel consumption on school buses was 7.6 miles per gallon. In Michigan our consumption runs about 5½ mile per gallon across the state. I say that with a little hesitancy. We have some school districts that keep records of fuel consumption and then we have some school districts that have no records. We also have drivers that don't keep records of fuel even though the school district attempts to keep records.

I have found in school districts that many drivers don't start the engines on their school buses in the morning; the mechanics go out to start the buses. We have found that when some drivers actually start the buses they go in to the garage for about 20 minutes for a coffee break and let the buses warm up. I always felt that if a mechanic went out to warm up a fleet of buses, it would take him one minute to get in the bus, start the bus and get it to run, and then go to the next bus. So, if you had a fleet of 25 buses the first bus would be running 25 minutes before you got back to it. I was in a school district last week and one of the mechanics assured me that it took two and a half minutes to start his buses. He has a 25 bus fleet and he has timed it and it took him an average of two and a half minutes to get the complete fleet started. We estimated it cost $55 every morning to go out and start those buses.

We did a little research and found that a school bus which was started on a cold morning, choke pulled out, turn on all accessories, we can consume a gallon of gasoline in nineteen minutes when idling. On a warmer morning when a choke isn't used and we don't turn on any accessories we can make a gallon of gas last up to an hour and two minutes when idling. A five minute warm up period is sufficient on some of the coldest Michigan days. If a driver starts the bus and runs it for five minutes and during that time make a pre-trip inspection, we figure a savings of two thirds of the gasoline normally consumed by starting it and letting it run twenty minutes. On a warm day, 20 degrees, idling about two or three minutes, we can save up to eighty percent of the fuel at starting time. We have 13,000 buses in the State of Michigan and if 10,000 buses warm up for 20 minutes we burn 10,000 gallons of gasoline before we get out of the parking lot and haven't performed any service.

If you save two thirds of that (6,000 gallons) at 80¢ a gallon, you will save $4,800 a day. We are pushing as hard as we can for controlled idling time and

we've convinced a number of school districts to try. I know that Norm Smith, the transportation supervisor, at South Lyons, has a program for idling time and his school shows a fuel savings. The Lansing Public Schools have begun a controlled idling time program and expect good results. A controlled idling time program is something that they do not want to volunteer to begin. They seem to be waiting to be told to begin. Many administrators are reluctant to begin programs which require a driver to do something or to not do something due to union contract implications. Drivers must be just as interested in conservation as the administrators if we are to cope with our fuel problem.

Let's talk about gasoline conservation and the automobile that stops for the school bus to load and unload pupils every morning and every afternoon. A warm automobile engine will burn a half ounce of gasoline during a 20 second school bus stop. We feel that it takes an average of 20 seconds of stopped time at each school bus stop. In Michigan we are making 400,000 bus stops two times a day, that's 800,000 stops each day and 140 million bus stops during the 180 day school year.

If only one auto stopped for the school bus at each school bus stop, the autos would burn 4.5 million gallons of gasoline each year. Added to that is the extra fuel that is burned when the driver drives away at a high speed to pass the bus to keep from having to stop behind the bus at the next stop.

In Michigan we have many high traffic volume highways and on these highways the pupils are usually delivered on each side of the road to keep the children from having to cross the road. The result is actually that we stop the traffic from both directions and the children do not cross. Then we turn around and go down the road in the opposite direction and stop the traffic in both directions again and again no children cross the road.

On some rural roads we stop to unload the pupil and stop the traffic and the pupil walks across in front of the bus. The bus leaves, the traffic proceeds, then the pupil goes back across the road to the mail box, turns around and crosses a third time to go to the house. Then he gets in the house and his mother wants him to go to the store and so he gets on his bike and goes down the road into town. Is it time to take another look at the school bus stop law and loading and unloading pupils?

Have you looked at the safety record lately? Nationwide for 1977-78 fifty-four children were killed in bus accidents. Twenty-three of them were killed when the motorist passed the stopped school bus in one direction or another. Thirty-one were killed when the school bus ran over the child. Are we really providing safe crossings or are we leading the children around in front of the bus so they can get

run over? It is like Russian Roulette!

We talk about safety, accident prevention, and energy conservation. Let's do something positive about it! The Department of Education has been looking at the safety aspect of the school bus stop law and we realize it isn't energy efficient and if this were a safety presentation we would be talking about accident prevention with the side effects of conservation. Since this is a conservation presentation, maybe we ought to talk about energy conservation with the side effects of accident prevention and life saving.

We have talked to people at the school district about athletic trips, field trips and increasing the walking distance and still face parents and politics. I think I mentioned last night Lansing Public Schools are running over 3,000 field trips every year, burning up fuel. Unless the Department of Education and superintendents go out on the bus lots and hold the drivers' hands we are not getting the idling time control we need.

We have to do something positive. At first glance, it may not be too acceptable to the general public; but I think after you think about it it makes reasonable sense. We are talking about modifying the school bus stop law and not requiring the motorist to stop for a school bus. We're talking about loading zones and we're talking about teaching children about pedestrian safety. I think the federal government has recognized that there is a problem with visibility in the school bus also.

I understand that the federal government has a visibility test procedure going on now. I don't know a lot about it, but it includes a drum with various gradations on it set in front of the bus driver who has to see certain gradations and determine visibility distance.

The federal government is talking about a new design which may eliminate the conventional school bus. We may be using a transit type school bus with glass domes where the drivers can see all around the front of the vehicles. They are trying to prevent accidents where buses run over children and with some other type of design the driver can warn the children so they don't run out in front of traffic. This means increased costs of new design in school buses.

If you take your child to a movie you don't stop traffic to let the child go across the street. They go to the corner. If they ride a city bus, they get off on the corner and go across with the light.

Some Indian Trails and Greyhound type buses have to stop on the highway in rural areas and people learn to be pedestrians and take the attitude of protecting themselves. I think maybe we should be teaching our children pedestrain safety.

We are almost to the point of saying maybe we should go to "no flashing lights" on school buses. One thing brought up last night was community busing. If we go to community busing in the years to come what kind of bus will we use? What color will it be? Probably not a black and yellow school bus and probably not with flashing lights. There will be different regulations governing it. We will have to educate the children to be pedestrains.

We are getting to the point like safety folks say, "You can't rely on the other guy." That is what we are doing in school busing, relying on the other guy to stop, and that is what is killing our children.

Our proposals are still within the local school bus section of the Department of Education and we haven't made any formal proposals to the state board. We feel stopping the other vehicles for the school bus may no longer be the best way to protect our children.

We know that it is not energy efficient if it is costing the public 4.5 million gallons of gasoline each year.

We are attempting not to let the child walk in front of the bus and not give the child a false sense of security that the driver won't run over the child with the bus or a motorist won't kill the child in the middle of the street.

Let's talk about alternate fuel to save gasoline energy. From our reports, the diesel buses are supposedly getting ten miles to a gallon. I don't know if it is regular runs or field trips.

We find the cost is about $3,000 more over conventional type of school buses. At one time, before gasoline costs went up, diesel was great. You could buy diesel fuel for much less and the economy was greater.

Now with diesel you have to depend solely on the economics of efficiency. In Michigan we are reimbursing 75% of the cost of the vehicle to the local schools over a seven year period. We haven't made any modifications to that reimbursement law to cover the added expense and supposedly added life expectance of the diesel engine. Maybe we should be reimbursing for nine or ten years for that diesel and maybe something similar with transits. You can buy a conventional bus for about $25,000. We amortize that over a seven year period and go out and buy a $40,000 transit bus, which is amortized also in seven years.

In some cases, the school districts are selling them off at the end of the seven years, feeling that that's the end of the life expectancy and don't take into consideration the possibility it might go farther without major repairs.

If all of the records are correct there is definitely a fuel saving by going to diesel engines. You will have to weigh that against additional cost and passenger capacity involved.

We have just gotten into the alternate fuel of propane and we are very interested in that. Propane is a dangerous word and everybody is scared to death of it. In doing a little research, I think you will find the volatility of propane is probably less dangerous than that of gasoline. It will vaporize almost immediately, of course, no vandalism.

In comparison to 87 octane gasoline, propane is more than 110 octane. You pick up only a little extra mileage in a propane bus. The real savings is in low engine conversion cost, reduced maintenance costs and low fuel cost.

So far only two buses have converted to propane. We have almost 1,000 carburetors committed from manufacturers. Carburetion is almost impossible to get. The manufacturer has not increased production to meet the demand. We are now working on the fleet in Charlevoix and Mr. Randall here is the first to use propane with two school buses. He is very happy with it.

We find we can convert a school bus safely and economically. A school bus can be converted for about $1,000.

I think when the buses were converted at Lincoln the propane was 44¢ and the other day was 50¢ a gallon. If you are comparing with regular gasoline to diesel fuel, it is less than twice the mileage at the same cost. In a diesel conversion when you sell a school bus you have sold the diesel engine and have to pay $3,000 for another diesel engine, but a $1,000 conversion for the propane set; you take it off your old bus and put it on the new school bus, the only cost is labor.

If everything stays the same, we will be able to take that carburetor off and maybe with an adaptor from a four barrel manifold to a two barrel manifold be able to put that same propane carburetor on our new school bus.

Maintenance of a propane carburetor is very simple. There are fewer moving parts in a propane carburetor and the cost of maintenance is inexpensive.

We don't want school districts making their own propane conversions. We don't want school buses operating on propane unless we have inspected them. When we are dealing with school bus propane conversions we want to be sure those people who are making the conversions know what they are doing.

It may become commonplace later on but right not we are still treading a little softly. I think it will be quite a money saver for us.

We are not having any tank conversion problem. We are taking the gas tank off and taking off the guard and installing the propane tank immediately behind the step well. It's higher than the bottom of the step well. We are going

from about a 20 gauge gasoline tank to about a 3/16" propane tank and all of the valve and fuel line outlets and vent outlets are safety checked with excess flow valves all mounted on top of the tank.

Question: During your investigation of this did you or anybody ever contact the Chicago Transit Authority? They had about 300 propanes in late fifties or early sixties and ultimately converted them to diesel. I don't know why. I also heard the reason they converted was because of an explosion problem. Has anybody tried to document this?

MR. LOUDERBACK: No

(Comment): It might be interesting to try and contact them to see what their experience has been. I think before converting to propane that we better check with somebody who operated and converted the 300 propane vehicles. Certainly we should take that into consideration.

MR. LOUDERBACK: We are aware that there were propane problems and people also got away from it because of cost involved. At that time diesel was so much less and gasoline so much less. We found that between the fifties and sixties conversion there has been a change in components. The carburetor is the same but the operation of the electric primer for cold weather starting has improved and valving and pressure lines are improved tremendously.

You have a couple of other things to look at in straight propane conversion. One is the engine oil change conservation. One oil change a year rather than several times. You are reducing the consumption of oil plus the cost of labor it takes to do this. You are talking about increasing the life of the engine by four times. If all of these things are true, propane could be a good conversion, good alternate fuel for us.

We had an offer from a corporation to go to a natural gas conversion, but the compressor pumped only vapors and tanks would be numerous to obtain much range. It is an alternate fuel and I understand that some municipal vehicles are going to natural gas conversion. For some it is an overnight fill and you have to have four or five tanks in the vehicle and you might have to set on the compressor overnight. There are some drawbacks.

I think we will have to get into some new thinking if we are going to continue fleet bus operation.

When Bill Myatt from Detroit Diesel Allison was talking last night about automatic transmissions, I heard some of you talking about breakdowns and having difficulty getting service or rebuilt units.

We weren't experiencing too many breakdowns or parts availability pro-

blems, but we were experiencing cost problems.

Improper diagnosis and sending a good transmission in for exchange for a rebuilt unit were problems.

We now have an automatic transmission rebuilding training program for bus mechanics which we developed through a mobile training unit provided by Ferris State College. Ferris teaches total overhaul and we expect to accomplish proper diagnosis and troubleshooting. We feel certain that we will reduce replacement costs through proper diagnosis.

We got into the mechanics training program in 1975 with Ferris State College when we discovered the inefficiences of school bus repair and maintenance. For example, alternators cost $149 each in 1975 for rebuilt units. It didn't take long to realize that diagnosis and trouble shooting an alternator was almost non-existent. Over six hundred mechanics went through a 16 hour alternator rebuilding classes in the last 4 years. We estimate that each school bus receives a new or rebuilt alternator at least once during its seven year service. In Michigan that amounts to 1,950 alternators a year at $149 each. An alternator can be totally rebuilt for about $30 and one hour labor. A cost savings of $119 per alternator if you do it yourself which results in a total statewide cost saving of over $200,000 per year.

The same savings is true with any repair where proper diagnosis is basic to solving the problem.

We are into alternators, carburetors, transmissions and doing a scientific diagnosis program. We do an electronic tune up program and we talk about batteries in this program. You would be surprised at the number of mechanics who don't know how to check a battery with a hydrometer.

We are getting deep into the mechanic training program and we have made a tremendous saving. We built 25 or 30 bus garages over the last five years.

In this state we have a state police annual inspection. Where I stand, I say every bus is going to be 100%. All lights have to work and everything has to work.

The state police inspection is not just brakes, lights, tires and glass. Our state police check it annually and check the first aid kit and everything that falls under the safety rules for the Department of Education. They have to meet all requirements of the federal government and all the requirements of the vehicle code.

This is a manual we publish and has everything to do with the state police

inspection. In Michigan if you have a '75 school bus, they look for some things, and for different things in 1972 school bus or 1978 school bus.

Our inspectors pull the wheel, measure the brake drum thickness and many other things. All of our inspectors have been through a training program.

We began a few years ago with state police inspectors, patrolmen who were good on law enforcement and could write you a speeding ticket in a minute, but didn't know a thing about school buses.

We did some training and they were making good inspections. We recognized there was a point where the mechanics were fooling them in inspections. We went out and hired fifteen civilian mechanics, put them in the state police department and these inspectors are required to be certified mechanics.

They have knowledge of the equipment. Our inspectors have come a long way. We expect a seven year old bus to be and look as good as a new one. With good brakes, no holes in the floor, tires in good condition, gauges, brake linings, exhaust, valves, hoses and everything.

We in Michigan feel that we have come a long way from the horse drawn school hack and feel that we administer very progressive thinking in school bus safety, maintenance and energy conservation.

MR. DOERR: Our next presentation will be by Mr. Bill Sulak. He is from the U.S. Department of Transportation and represents a joint venture with the Department of Transportation, the Department of Energy, and Environmental Protection Agency called the Voluntary Truck and Bus Fuel Economy Program.

I am pleased to say that the State of Michigan is proposing to participate in the Voluntary Truck and Bus Fuel Economy Program in the coming year. It is very worthwhile.

I am very grateful that Bill took time out to come down from Washington and give us his presentation.

MR. SULAK: Thank you very much. I would like to start out with the two biggest lies in the world, the federal bureaucrat who says, "I'm here to help you" and the pupil transportation supervisor who says, "I'm glad to see you." Well, I'm here to help you.

I would like to say a little about the Voluntary Truck and Bus Fuel Economy Program. After 1975 when the Conservation Act was passed by Congress, the Department of Energy, Department of Transportation, and Environmental Protection Agency wanted to examine the full gamut of fuel conservation. One of the important points for the commercial segment of industry was that fuel economy could best be obtained by voluntary means, as opposed to regulations. Thus was born the Volutary Truck and Bus Fuel Economy Program that I am part of.

We have 240 members from manufacturers, owner operators, trade associations, some bus companies, and all the major manufacturers. Unfortunately, we haven't been able to get our own people into it from the government other than our three organizations.

I guess the reason we were interested in school bus fuel economy is that buses have a high visibility. Also, I think kids, as mentioned in one of the talks here, are quite aware of the school using conservation methods in school buses. They pick up things like this. If they see adults practicing it, it spills over into the community. A lot of it is going out and publicizing to local PTA's and school boards what you as supervisors in transportation are doing to conserve fuel.

Therefore, we developed five booklets on saving school bus fuel. They are written in terms so that you can go out and hand them out not only to your drivers, but the community as well and possibly get your students involved in this type of program.

We also came out with "Encouraging School Transportation Effective Energy Management". We call it ESTEEM. This book is primarily aimed at the transportation supervisor to aid him in determining areas you want to look at in school buses when you are determining how to save fuel. It explains some of these areas for you and

also shows how to go about it in terms of keeping good data records and also using the fuel with the greatest cost payback, using simple basic business management application in figuring out your payback for some of these devices that you want to put into your bus system. How can you justify paying $4,000 for a diesel engine in terms of payback and how can you go to the State and ask to extend reimbursement in the area of seven or five years and make it twenty years? You have to have facts, and more important you have to go to a school board and talk to them as well. Sometimes they are not easily convinced.

I don't need to say that you are saving money, for example, if you are operating 10,000 miles a year and get six miles a gallon and spending $1100 for fuel. This is based on '73-'74 economics, of course. Now, when you are paying $1 a gallon that increases to $1700 a year for fuel. If you are getting eight miles per gallon, you can save $417 per vehicle per year. That is quite a substantial savings.

I think that you not only want to save fuel, but you want to look good in the community and be a community leader. Toot your horn about saving the taxpayers money. Not only is government drawn on the carpet for wasting taxpayer money, but the board is called on the carpet for spending taxpayer money. Put the money to better use by purchasing equipment and training people.

I have found that a lot of school boards are willing to pay for a good transportation supervisor, but not willing to put out money for good mechanics. Consequently, when a lot of mechanics become trained, they will go to private industry.

You can use fuel economy as a training aid. Bring students in, let them look at the problems and have them come up with solutions in saving fuel. Implement some of their ideas. It is a training and teaching experience all the way around.

I think one of the things we found in the voluntary program in heavy trucks for fuel conservation is you can't go right across the board and apply regulations. They are too diverse in operation, and I think the same thing about school buses. There are similarities, but your operation may be different than the next one, and operate on dirt roads rather than paved roads and have a bigger budget than the other school districts.

I can't overstress the importance of keeping records to identify maintenance care to the chasis, body, and transmission. How much fuel you can account for, gasoline versus diesel, and also maybe bigger buses versus smaller buses versus different routes. You need records for these. This is the kind of data you need when you go in and justify spending money. I think these records will help determine if you need a big bus or small bus for some of your operations. There is a tendency in some of the school districts to go ahead and buy large buses, when in some cases they may not need that big a bus.

Also, look at the possibility of smaller engines. Many sold are too large. Sit down and figure it out. I think a lot of manufacturers now have a computer program to go into the district and help set up what kind of operation your buses perform everyday. You can then determine the correct type of bus for your area.

The bigger the engine, the more fuel wasted, and if you don't need it consider going to a smaller one. The same thing with the rear axle. You may not need a higher ratio. These are some of the areas you want to have some knowledge of. You may want to consider automatic transmissions. Some school districts have seen a fifty percent increase in fuel economy with automatic transmission coupled with diesel.

You have to impress your drivers with the importance of tune-up. You have one plug misfiring in a V8 enginer and you can use up to seventy percent more fuel than you need to. Maybe at a lower speed, it would be a lower percent, but it is still loss of fuel that you may be able to save.

Radial tires increase economy over six percent. Radial tires are susceptible to scuffing, however. That may be a problem. Fan clutches give almost six percent fuel saving.

How do we use fuel economy measures in terms of the community? We instituted one of these programs in the Maryland area, and one of the questions that came up was, "How do you know this will work?" I don't know that it works, but it seems pretty feasible, especially now with the cost of fuel the way it is. We are trying to sell this program by going into the community.

You are under the gun in conserving costs. You take the offensive and tell about your campaign to save fuel and give the public the results of the tips you have found and it will carry over to the people in the community in terms of saving gasoline and rubber.

Involve your drivers and make it a contest. Train them and then watch them go with your guidance. You want to involve people in PTA meetings and have drivers come in and tell how they save fuel and what steps they take. Let them know what you are doing.

You need the most favorable routing, but you have parent complaints. A lot of people will keep their kids in the house until the last minute and when the bus gets there then they run out. That takes idling time. You can't always explain that to a parent.

Fuel conservation depends on both equipment and people. You can have the best equipment in town, but if people won't use it correctly, you are in trouble. You have to have everybody take part.

What works on your buses will probably work on cars also. The effectiveness of your program, if well publicized, will spill over to the private cars

operated by school system employees, students, and their parents.

Take credit for being a leader in your community - saving scarce resources and saving the community money. Publicize your program! Use fuel economy as a school science project. Keep an open mind. Be willing to try new ideas. The publicity and interest developed by community participation will be to your benefit and you might find just the combination needed for greater fuel savings.

One of the main objectives is to set-up particular sets of standards for fuel economy. Everybody can apply their vehicle needs to this in order to participate in this particular operation.

One of the tests we have developed is a Type I test procedure on SAE recommendations. It compares easily installed equipment such as; van clutches, radial tires, and other items. You can guage one vehicle with and without equipment in terms of percent of fuel efficiency and learn if you have something that works. That is one of the things with the advent of fuel economy devices. You can't believe the amount of devices on the market, but when you ask people to submit their produce to this test, that amount diminishes.

We are developing a Type II test for harder to change components; engine, rear guard liner, and transmission. It will take a test vehicle with an old type engine, run it down the road, and after a certain amount of time, bring it back, change the engine and run it out again with the comparable vehicle. Then you can determine the particular percent of fuel savings based on that component.

We use the control vehicle to be able to see the operation of the same type of vehicle by changing the engine or transmission. This may take more than two or three days with changes of weather and conditions.

Right now we are in the process of developing an available general schedule that represents school bus operation. They have done this by going out to various school districts and recording actual bus operation and actual things done.

They have a device that measures the velocity and actual DMR for the vehicle as it goes through its normal operation. We hope to develop a representative cycle we can apply to a bus that is coming off the manufacturer's line to determine what kind of vehicle efficiency it does have with those components on it. You, as the use, could probably rely on that data and go ahead and compare it with your own vehicles and stipulate that you won't buy that vehicle unless it performs with the prescription recommended or prescribed SAE procedure.

COMMENT: Is the federal government doing anything to unify busing rules for the nation instead of separate regulations at local and state levels?

MR. SULAK: Fortunately, I can address the energy aspect of school bus transportation and my counterparts can address the safety portion of school bus transportation. Unfortunately, HEW and the newly created fuel allocation act has to address that. I would imagine that may be better solved at the local level.

I think one of the things we would like to look at is a voluntary program. It takes a lot of initiative to get out and do things before you are prodded to do them. I think, in fact, if you get out there and do a lot of things before somebody has to tell you to, it is to your advantage. I think you would have more input in getting it done. You don't need engineers coming in and telling you what should be done across the board, and we don't go off like horses charging across the sunset with federal mandates.

COMMENT: You may get ahead and sometimes you get penalized. We have a fuel allocation based on two years ago. The school district working to economize that year is penalized this year.

MR. SULAK: This is a problem we are facing in the voluntary program now and something we will have to address in the near future.

One major fleet increased uasge by 32% and during the allocation time this was cut as well, and if you look at it, it will encourage you to use more fuel. This problem will be the life or death of our voluntary program. We are concerned and we will be working on it. I was talking about this with my counterparts in the Department of Energy before I came on this trip.

Any other questions or comments?

QUESTION: Outside the testing, is there anything else you want to get into?

MR. SULAK: We will be looking for various school districts to voluntarily submit their vehicles for this Type II testing when we get into a procedure that we can use as a base line to compare against. We would welcome school districts that would be interested in participating. It would take probably a week and probably be in June. We would like to see what kinds of problems we experience in Maryland and once we are through there we can can set up pilot programs.

QUESTION: Another point brought up was transportation coordination within the community, including volunteer drivers for social service, taxi service, and whatever. It is to fully utilize the system as opposed to school bus versus transit bus. Any directions along that line?

MR. SULAK: That would be further on. You have more problems putting on more mileage and requiring more maintenance. You have to look at the entire gamut. It would seem like a feasible idea.

QUESTION: Is there such a thing as an inline metering device which would actually allow you to measure the amount of gasoline used at a certain period of time?

MR. SULAK: A flow meter.

QUESTION: Could you use one on the car?

MR. LOUDERBACK: Yes, I have one on my car. It measures the fuel flow by light impulse measure. The light bulb in the little wheel turns and measures the blips. It is a digital read out. It measures miles per gallon. It gives you average miles per gallon instantly and it gives you total amount of fuel you used.

QUESTION: If I use it and drive from here to the office, can you figure how much fuel you used driving from here to the office?

ANSWER: Yes, you set it. It also incorporates an electric clock and you calibrate that and it gives accurate speed and elapsed time and distance traveled and estimated time of arrival. Quite a little box - full of good stuff. It has two connections; one in the fuel line and the other is spliced into a speedometer cable with those two and a built-in electric clock. You can do anything you want with it.

QUESTION: What price?

ANSWER: This one was made in Holland, $428.

MR. DOERR: Well, we have come to the time to wrap-up this session. We are very grateful to everyone in attendance and special thanks to the presentors and everyone for their cooperation.

As you know, we participate with six other states that make up Federal Region V. For the wrap-up, we have the Director of Operational Projects, US DOE Region V, Mr. Ken Johnson.

MR. JOHNSON: Thanks a lot. The good news, gentlemen, is that it is getting close to noon and I am not going to talk very long. I would like to say a few things because this has been a real learning experience for me.

I have been in government for four and one-half years. Most of the time has been in the office and very little time has been spent on trips in the field on transportation. I think I have learned more in the last day and a half than in the last four years. I really appreciated it and realize that you can aid me, but in some way I may be able to help you at the regional level in the months to come in this important area.

Our operation is divided into ten regions. We are in Chicago in Region V and we encompass six states, including Michigan. I have a small staff whose main mission is to monitor grant programs mostly with state offices. Another group of programs deals with weatherizing homes for low income and handicapped. We work through the Community Action agencies and Energy Extension Service Program which is going nationwide. Michigan had an exceptionally fine demonstration program going over the last year.

On the problem of transportation, we never had staff authorization (per se) to do good things at a regional level. We do what we can and recognize this as an

extremely important area. We would like to help out. We would like to help with the energy program through people like John Sarver of the Michigan Energy Administration, and to work with energy conservation in the states and try and do as many programs as we can with federal funds dealing with energy conservation and transportation. I can't believe it won't accelerate over the next two years. Senate Bill 1030, the Conservation Act of 1979, which is now in effect, will require the states to come up with contingency plans. The President now has authority to come up with gas rationing under extreme conditions. We will be more concerned with fuel allocations and we don't have to discuss the problems and the reason we are all here. It is extremely interesting to get into specific areas like you have been doing here.

I am already talking to experts in kicking things back and forth and obviously you know the problems and are doing the best you can to solve them.

We are on a small scale finding out what kind of meetings or conferences we need to hold in the next six months in a wide variety of areas.

We work a lot with school districts. The major problem is our work has been in the school districts with buildings and facilities and little of it, at least out of my office, has been in the transportation area, mainly because we havenit the staff and organization for these kind of energy programs.

The day after Christmas and the day after that I am running two workshops for 600 operation and maintenance men with AFL Local 143, the maintenance men in the Chicago school district. We are going to measure maintenance operating training program for building custodians in the schools.

We are going to be doing that program for them for each of two days. We will be discussing a temperature restriction program and our school hospital grants program. We are not doing what we should do, which became fairly evident to me today, in the pupil transportation area. If nothing else, the impact of what you have been talking about has really struck home.

We are going to be working more closely with Bill Sulak in Washington and with the Federal Highway Administration in the DOT. I appreicate Hank Doerr inviting me here for this conference. We will do the best this year we can to do something further.

Again, it has been a real pleasure being here. Thanks very much.

Group Discussion of Goals and Policy Directions in Maximizing Energy Conservation in the School Transportation Fleet

Those present were divided into two subgroups for the purpose of conducting an abbreviated nominal group process to determine and prioritize important issues in maximizing energy conservation in school fleet management.

Each group began by randomly listing needs for improving conservation practices. To begin the process, each participant was asked to write down five to eight items important to a successful energy conservation program. Then, within the groups, each person was asked to present one or more of his responses to make up the group's list.

Below is the list generated in Group One.

1. Control school starting and dismissal time.
2. Convince public of energy problem.
3. Develop long-range fuel allotment program with equity as a goal.
4. Improve driver training program.
5. Develop an equitable rationing program for general use.
6. Improve preventive maintenance program.
7. Infuse energy education into curriculum in support of school conservation programs.
8. Investigate advantages of four-day and six-day school schedules.
9. Develop a more effective federal-state-local coordination plan.
10. Establish measureable conservation goals.
11. Coordinate local, municipal and school transportation.
12. Develop a unified federal energy conservation program.
13. Establish an energy information clearinghouse.
14. Research the value of education field trips.
15. Establish an incentive program for school employees (bus drivers).

Group Two generated the following list.

1. Optimize BTU consumption in pupil transportation.
2. Establish specific energy conservation goals.

3. Establish national funding support for research and development in energy conservation for the school fleet.
4. Establish a program to set examples for the community.
5. Avoid cross-town busing.
6. Develop a program of information sharing and identify relevant linkages.
7. Develop a system that bases funding for the transportation fleet on efficiency.
8. Educate all (students, staff, community) in understanding the need for energy conservation.
9. Develop and disseminate a common energy vocabulary of both technical and general terms.
10. Identify existing state legislation as it impacts energy conservation in the school fleet.
11. Develop state-level computer models for use by local districts.
12. Provide leadership in establishing commitment to energy conservation.
13. Eliminate unnecessary school transportation.
14. Develop more efficient buses and other equipment to increase energy efficiency.
15. Develop a system to tie funding to policy and procedure development.
16. Establish a coordinated system at the national, regional, state and local levels to provide clear and coordinated policy and regulation direction.

Each group then consolidated and prioritized their list to arrive at goals they considered most important. Group One listed five major goals:

1. Convince public of energy problem.
    a. Develop a K-12 energy curriculum to create awareness among pupils, among school employees, and among school families.
    b. Establish an information clearinghouse for energy conservation.
2. Improve fleet operational efficiency through:
    a. School scheduling.
    b. Preventive maintenance program.
        1) Better training program for school employees.
        2) Better control system for operating time and general management.
    c. Establish driver incentive program.
3. Establish measurable conservation goals for the transportation fleet.
4. Establish a system of cooperative community busing.
5. Establish a rationing system for general fuel use.

Group Two listed six major needs:

1. Develop a system of R & D funding to develop new techniques and technologies in energy conservation for school fleets.
2. Develop a system of local funding for transportation which considers efficiency as one criteria for funding level.
3. Develop an energy conservation education program to instill an understanding of the energy problem and related vocabulary into student, staff and community members. Instill the energy ethic through example and curriculum.
4. Develop inservice programs to train school personnel in understanding the need for energy conservation, the vocabulary of energy conservation, techniques for increasing driver efficiency, and techniques for managing the energy program.
5. Develop a system which assures the commitment of national and state leadership in identifying the short and long-range needs in maximizing energy conservation and establishing linkages to encourage the development of policies and procedures addressing the energy crisis.
6. Develop a total system of transportation which includes school and community systems to avoid duplication of services.

The two groups then met together to consider some of the major strategies needed to address the concerns identified in the two groups. To address the needs expressed for an energy education system, the group identified three types of action.

1. Develop a regional level energy consortium to establish a linkage system for energy conservation information, and to identify areas needing further development.
2. Develop a national policy on energy conservation education for use in K-12 schools. No strong or coordinative policy presently exists for utilizing or for involving education in the national energy conservation effort. This is a high-priority need.
3. Develop a national clearinghouse for energy information linked to regional centers and states.

A second major goal common to both groups dealt with the development of state and local funding systems to maximize energy conservation in the transportation fleet. Participants identified the following actions as vital components in achieving that goal.

1. Legislation and supporting rules that measure and reward efficiency in transportation.
2. Development of local district policies that support energy conservation in transportation.
3. Implementation of a management system to carry out the energy conservation program.

APPENDIX TWO

SCHOOL TRANSPORTATION SYSTEMS
750 Brooksadge Boulevard
Westerville, Ohio 43081
614/391-6696

102 WAYS TO CONSERVE ENERGY

IN SCHOOL TRANSPORTATION SYSTEMS

ENERGY CONSERVATION

Energy conservation in school transportation is a major area of concern to the education community. School buses travel in excess of four billion miles annually, consuming 900 million gallons of fuel and transporting 55 percent of the school enrollment.

Since the energy crisis descended, school transportation managers have initiated efforts to reduce the amount of fuel required to operate their fleets. Rapidly escalating fuel prices and limited school budgets are forcing a strong stand for conserving energy.

Listed below are 102 ways transportation managers can conserve energy and reduce transportation costs.

A. Transportation Policy

1. Coordinate school calendars and start and dismissal times between schools of each school system.
2. Eliminate staggered dismissal times in the same building.
3. Increase requirements for walking distances to school and to bus stops.
4. Establish take-up and dismissal schedules at schools to support maximum vehicle utilizations.
5. Eliminate buses for detention students.
6. Limit student parking, encourage high school pupils to ride school buses, form car pools, etc.
7. Establish maximum distance for co-curricular trips (60 miles round trip).
8. Utilize public mass transit where feasible to avoid duplication of service.
9. Establish travel restrictions for school sponsored activities supporting athletic teams (cheerleader, band, pep clubs, etc.)
10. Eliminate buses for athletic team practices.

B. School Bus Operation: Activity and Field Trips

1. Reduce, consolidate or eliminate all but the most necessary athletic contests.
2. Reduce, consolidate or eliminate all but the most necessary co-curricular trips.
3. Combine co-curricular and athletic trips for more than one school.
4. Have districts share buses when feasible.
5. Establish minimum and maximum distances for all trips.

6. Limit co-curricular trips to full bus loads only.
7. Combine athletic schedules so several games can be played at the same location.
8. Eliminate buses for transportation of students involved in after-school activities and for extra curricular activities for small groups.
9. Contract with parents to provide transportation when feasible.
10. Utilize public transportation on return trips where feasible rather than return school buses to schools or homes.

C. School Bus Operation: General

1. Lengthen distances between pick-up points.
2. Establish collection points.
3. Plan stops on level instead of on grades.
4. Consolidate loads.
5. Plan routes to make as many right-hand turns as possible to save on ilding time, where safety permits.
6. Use intercoms on buses to reduce stops for controlling discipline.
7. Use trip recorders to record and monitor driver and vehicle operation for speed control where problems occur.
8. Use smallest available vehicle for long distance, light-load runs.
9. Install two-way radios to direct operation or redirection of buses to avoid unnecessary stops and route miles.
10. Route bues to stay on main roads as much as possible.

D. School Bus Routing and Scheduling

1. Fill buses to leagl capacity.
2. When replacing buses or expanding fleet, purchase buses with capacities to provide balance fleet utilization.
3. Utilize proven updating routing techniques, either by hand or computer or maintain maximum vehicle utilization at all times.
   a. Evaluate current system.
   b. Revise system to reduce mileage, stops, and student riding time and distance.
   c. Review policy and revise where needed.
4. Consolidate inter-district transportation systems when possible to meet special transportation demands.
5. Develop an alternate routing plan for implementation in emergencies and fuel shortages (weather, etc.)

E. School Bus Operation: The Driver

1. Retain experienced drivers as long as possible.
2. Re-educate bus drivers toward better fuel economy.
3. Reduce warm-up time on buses to 2 minutes initially, and 3 minutes.

prior to starting routes. Driver should dress warmer rather than running engines at full idle to heat buses.

4. Drive slowly the first few miles until vehicle warms up.
5. Avoid full throttle operation. Drive at steady speeds.
6. Avoid the "red line" even in shifting gears.
7. Drive slowly back to bus garage. Turn corners slowly, drive next to center line on curves.
8. Reduce speed limit to as low as practical.
9. Avoid courtesy stops (unauthorized).
10. Train new drivers on existing runs while bus is "deadheading.
11. Use simulators to reduce behind-the-wheel training in vehicles.
12. Increases frequency of driver in-service programs.
13. Hold joint workshops with drivers and mechanics to improve transportation operation.
14. Use driver incentive system for reducing vehicle fuel consumption.
15. Review driver times and routes. Determine most efficient vehicle utilization, layover and storage plan to determine miles for school as well as personal vehicles.
16. Keep foot off accelerator when the bus is approaching a stop or is stopped and off brakes when in motion. Reduce braking by anticipating stops.

F. School Bus Maintenance

1. Tune and maintain engines, plugs, points, timing.
2. Maintain clean pollution controls.
3. Keep gas tanks full to avoid excessive evaporation.
4. Avoid fuel spillage when refueling buses, Do not "over fill." Do not fill to top of filler tube.
5. Replace buses that use excessive amounts of fuel as soon as economically feasible.
6. Keep fuel storage tanks locked with one person in charge of fueling of buses and other school vehicles.
7. Keep accurate bus records for maintenance and fuel consumption.
8. Analyze cost data, make management decisions to maximize savings and efficiency.
9. Inventory all parts and supplies and order on a planned-need basis, with best price and base of past experiences. (reduces "parts chasing")
10. If possible, in winter keep all buses under cover rather than allowing drivers to take them home.
11. Use engine warmers for easier starts. Utilize automatic timers to minimize use of warmers.
12. Maintain clean oil and air filters.
13. Keep automatic choke clean. A sticking choke will waste fuel. Chemical cleaners save costly down time.

14. Keep air-fuel mixture of carburetor precisely adjusted.

15. Regulate oil change with engine tune-up.

16. Use manufacturer's recommended weight of oil. A heavier oil will force the engine to use more fuel, too light will not provide the protection required.

17. Check tire balance and wheel alignment to avoid "drag" which will use more fuel and shorten tire life.

18. Check radiator thermostat. A defective thermostat may prolong engine warm up, increasing fuel consumption.

19. Use proper octane rated fuel. Using wrong octane will result in plug foul up and reduction of mileage. Using a higher octane than required is a waste of money.

20. Use engine analyzing equipment to assure maximum efficiency.

21. Make full utilization of service manuals and maintenance bulletins to keep updated on maintenance techniques.

22. Take full advantage of free maintenance training clinics conducted by skilled instructors.

23. Keep brakes properly adjusted.

24. Repair engine oil leaks.

25. Install radiator shutters for retaining engine heat.

26. Install radial tires.

27. Retrofit with electronic ignition system.

28. Properly utilize proven fuel and oil additives.

29. Maintain proper tire pressure on a regular basis. Proper tire inflation is essential to fuel economy and tire wear.

30. Utilize new techniques such as rubber suspension systems, wheel balancers, tire pressure equalizers, solid state ignition, etc.

G. Transportation Office and Garage

1. Maintain lighting fixtures (a clean fixture in good working order can deliver up to 50 percent more light).

2. Clean walls and ceilings and/or paint with light flat or semi-gloss finish.

3. Turn off all lights and other electrical equipment when not in use.

4. Reduce exterior lighting to lowest level consistent with good security and safety.

5. Perform janitorial services earlier so that electricity may be turned off earlier.

6. Check all equipment and motors. Adjusts belts for proper tension; turn off when not in use.

7. Limit the use of electrical space heaters.

8. Tighten and clean all electrical connections from the circuit breakers back through the transformers to the main switch. (Should be done annually by an experienced electrician when building power is off).

9. Consider the installation of photo cell controllers to turn exterior lights on and off.

10. Concentrate evening work/meetings in a single heating/cooling zone instead of heating or cooling the whole office or garage.

11. Clean up heat exchanger and heating coil surfaces for better heat transfer, change filters at regular intervals, clean fan blades and damper blades.

12. Request visitors and staff to avoid waste of energy by opening windows, or holding doors open.

13. Consider the installation of added insulation to building walls and ceilings to decrease heat transfer.

14. Consider the installation of insulating glass in place of single pane glass.

15. Consider the installation of weather-stripping, caulking, automatic door closers, etc., to decrease infiltration of outside air.

16. Close off all unnecessary openings--unused exhaust fans, broken windows, structural openings.

17. Replace grossly oversized motors. Motors operate more efficiently near rated capacity and with a better power factor.

18. Utilize blower system to circulate warm air from the ceiling to floor of work areas.

19. Remove thermostats located near doors, windows or heat producing sources.

20. Reduce thermostat setting on weekends, holidays and at night.

21. Install large fuel storage capacities, 10,000 gallons or larger. Lower fuel costs (drop/shipment) provides cushion in the event of embargo.

STS

FUEL ECONOMY THROUGH TEAMWORK

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A BASIC UNDERSTANDING OF ENERGY

What is Energy?

Energy is the capacity to do work. The rate at which energy is generated to perform the work is called "power." Energy can take many forms: mechanical, chemical, electrical, thermal, and nuclear. It can also be transformed from one form into another.

Where Does Energy Come From?

Petroleum, natural gas, coal, solar, wind, and geothermal energy are natural energy sources. Electricity is generated by fossil-fueled, nuclear, and hydroelectric power plants. Together, these resources provide the ingredients that are necessary for our standard of living.

How Much Work Will Energy Do?

Energy is measured in terms of British Thermal Units (BTU's). A BTU is the amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit. Energy may also be measured in terms of barrells of oil. The following tables show the amount of energy required for typical activities in our economy and BTU equivalent values of common energy and fuel sources.

ENERGY WORK EQUIVALENTS OF OIL

1 BARREL ...	DRIVE A SCHOOL BUS FROM AMARILLO, TEXAS TO TULSA, OKLAHOMA; A DISTANCE OF 350 MILES
100 BARRELS ..	TAKE A LOADED JETLINER FROM CHICAGO TO WASHINGTON, D.C.
1,000 BARRELS ..	RUN THE CITY OF BALTIMORE, MD. FOR ABOUT 10 MINUTES

BTU EQUIVALENTS

1 BARREL OF OIL	5,800,000 BTU's
1 GALLON NO. 2 OIL	140,000 BTU's
1 GALLON GASOLINE	125,000 BTU's
1 KILOWATT-HOUR OF ELECTRICITY	3,413 BTU's
1 CUBIC FOOT OF NATURAL GAS	1,031 BTU's

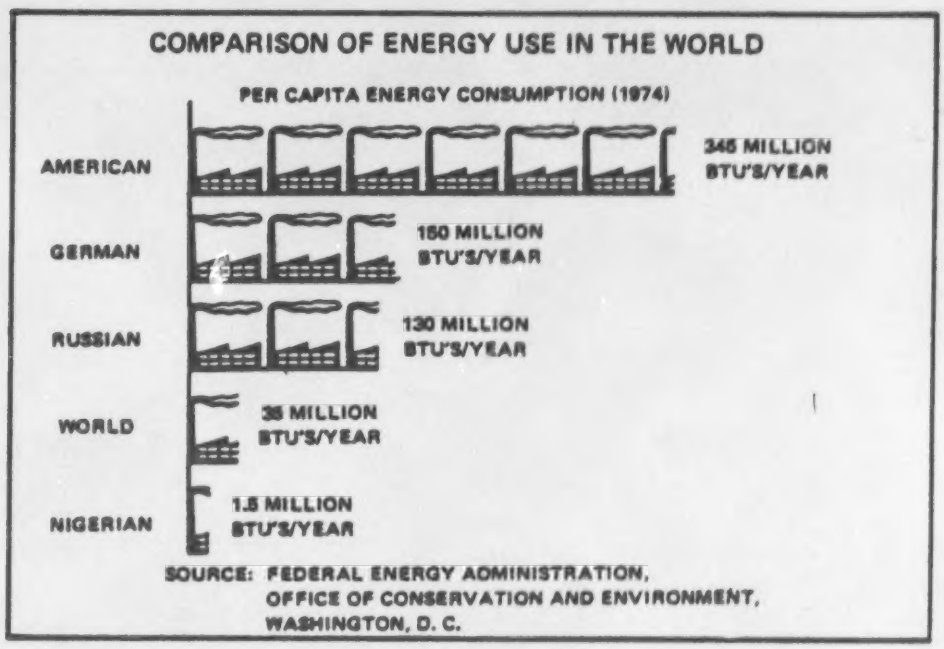
TRANSPORTATION IN THE U.S. USES ALMOST 9 MILLION BARRELS OF OIL EACH DAY

1. HOW MUCH ENERGY DOES AMERICA USE?

America has 6 percent of the world's population. Our nation produces over 30 percent of the world's goods; we consume nearly 31 percent of the world's energy.

To supply our entire national energy needs, America uses over 33 million barrels of oil equivalent energy (i.e., energy in all forms) each day. Oil provides 46 percent of this energy--about 15 million barrels each day. The balance comes from coal, natural gas, nuclear power, hydropower, and geothermal energy sources.

Per capita energy consumption in the U.S. was nearly ten times greater than the world average in 1974 as shown below.



2. WHERE DOES THE ENERGY GO?

Industry consumes about 40 percent of the energy in the U.S. The transportation sector uses another 30 percent. The balance is consumed by the residential and commercial sectors of the economy.

Nearly 50 percent of the energy consumed is non-productive energy. This energy is lost in the form of waste heat and to overcome forces such as friction in processes.

No process is 100 percent energy efficient. Energy is always lost. Electric motors, for example, convert electrical energy into mechanical energy. They generally have efficiencies ranging between 58-92 percent. The average boiler's efficiency is about 74 percent. Electric generators have efficiencies of about 25 percent. EPA (1) studies have shown that the efficiency of a motor vehicle--that fraction of combustion heat which ends up as mechanical power--can be as high as 30 percent; it can also be as low as 5-10 percent--depending upon how it is operated, where it is used, and how well it is maintained.

3. WHAT CAN BE DONE TO REDUCE ENERGY USE?

The most important step that can be undertaken is to use energy more wisely:

- o Purchase products that use less energy.
- o Use equipment that offers energy savings.
- o Construct buildings and facilities using principles that conserve energy.
- o Practice energy conservation in every day activities as a way of life.

Take advantage of available equipment and fuel saving practices that save energy and hold down costs. Operate for energy savings. Make such practices a permanent part of your school district's management program.

Fuel savings are obtainable in every school district's transportation fleet. This was demonstrated during the days of the oil embargo. Become knowledgeable about fuel saving techniques and keep practicing them. We can do something about eliminating energy waste, increasing energy efficiency, and controlling energy costs.

BTU'S CONSUMED BY ONE MOTOR VEHICLE EACH YEAR

MILES DRIVEN EACH YEAR	VEHICLE MILES-PER-GALLON 3	5	10	20
6,000 MILES	250 MILLION	150 MILLION	75 MILLION	38 MILLION
18,000 MILES	750 MILLION	450 MILLION	225 MILLION	113 MILLION

4. WHY IS ENERGY CONSERVATION IMPORTANT TO THE SCHOOL DISTRICT?

The energy crisis following the oil embargo of October, 1973 demonstrated the vulnerability of all operations, including school districts, to increased fuel prices and in instances the unavailability of fuel at any price. There is no assurance that yet another embargo could not take place in the future.

The sharp rise in fuel costs has placed a burden upon school districts. As prices go up, business may pass on these increases to its customers. The school district on the other hand has to work within its limited budget. Its principal alternatives to rising costs are to lay off personnel, reduce the level of services, or otherwise find additional funds.

A school district has one other alternative. It can use energy more wisely by implementing fuel conservation techniques. Some techniques are relatively easy to implement and require little effort and cost; others require an investment--sometimes it takes money to save money.

5. WHY IS ENERGY CONSERVATION IN PUPIL TRANSPORTATION A MAJOR AREA OF CONCERN?

Pupil transportation is among the important services that are provided in a school district. Yet, all too often it is taken for granted.

Everyone expects daily schedules to be met and extra curricular activity trip needs to be accommodated--in a safe, dependable, and economic manner. Each pupil transportation director must fulfill a mission which can be described as providing the best possible service at the least possible cost in a manner which offers no compromise for safety.

The U.S. National Center for Education Statistics show that in the U.S. nearly 275,000 school buses travel 2.8 billion miles to transport 23 million children attending grades K through 12. School buses use over 350 million gallons of fuel annually to transport about 52 percent of all pupils in our country. This represents an energy consumption of 43,750 billion BTU's each year--about 7.5 million barrels of oil.

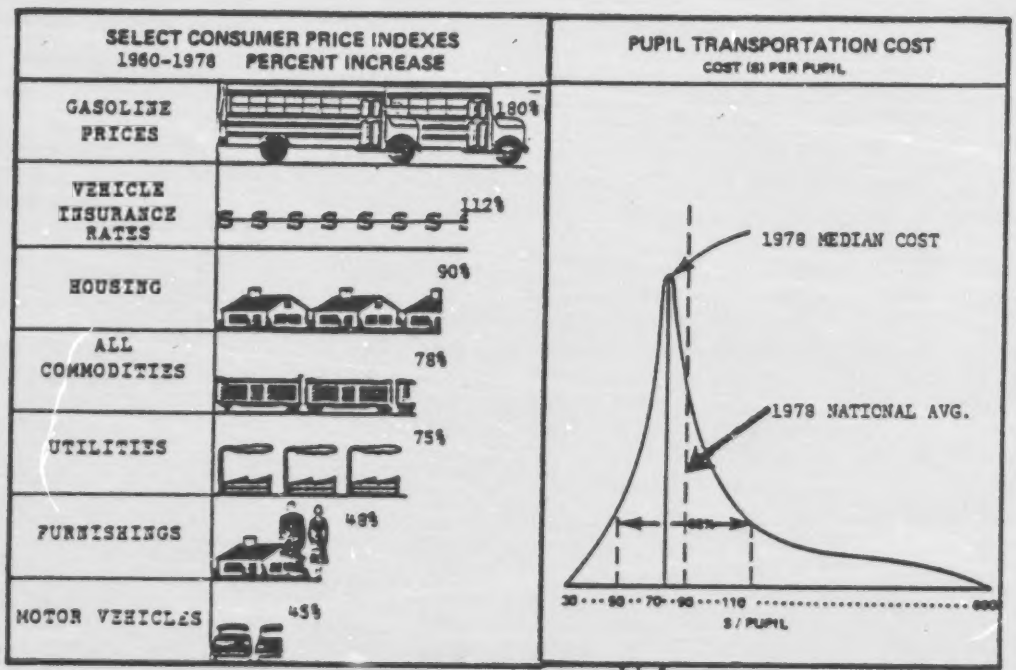
> THE WAY PEOPLE TALK ABOUT COSTS, ANYONE WOULD THINK THAT TO SAVE FUEL ON ONE SCHOOL BUS WAS A MATTER OF LIFE AND DEATH. THEY DON'T UNDERSTAND. IT'S MUCH MORE SERIOUS THAN THAT!
>
> ANONYMOUS

6. WHAT MOTIVATION IS THERE FOR CONSERVING FUEL?

Rapidly escalating prices and limited school budgets are among the principal forces for implementing fuel conservation actions. The satisfaction in knowing that the community is being provided the best service at the lowest possible cost is also important.

All commodities have increased significantly in price over the years. Gasoline prices alone increased 180 percent between 1960 and 1979. In 1979, school districts had to purchase gasoline at a cost which amounted to a 50-60 percent increase over the 1974 fuel price levels. These costs are still on the increase.

The average cost to transport a pupil in 1975 ranged between $43-$210 throughout the nation; the costs in some districts serving a small population over a wide area were as high as $600. Saving fuel and dollars has to be important to every school district. Furthermore, these goals can be achieved relatively easily.



7. HOW CAN PUPIL TRANSPORTATION COSTS BE REDUCED?

Each dollar spent for pupil transportation pays for salaries and benefits, fuel and oil, supplies, maintenance, equipment purchases, insurance, and other needed items.

School transportation policies, purchasing practices, maintenance programs, vehicle use, school bus operation, driver skills, scheduling, and routing are representative of areas that can be investigated to obtain more pupil-miles-per-gallon. Look at ways to increase fuel economy, reduce transportation costs, and increase servicing efficiency. A cooperative fuel economy management program involving school administrators, staff, teachers, students, and parents working with the transportation department can generally increase the effectiveness of every district's service to the community.

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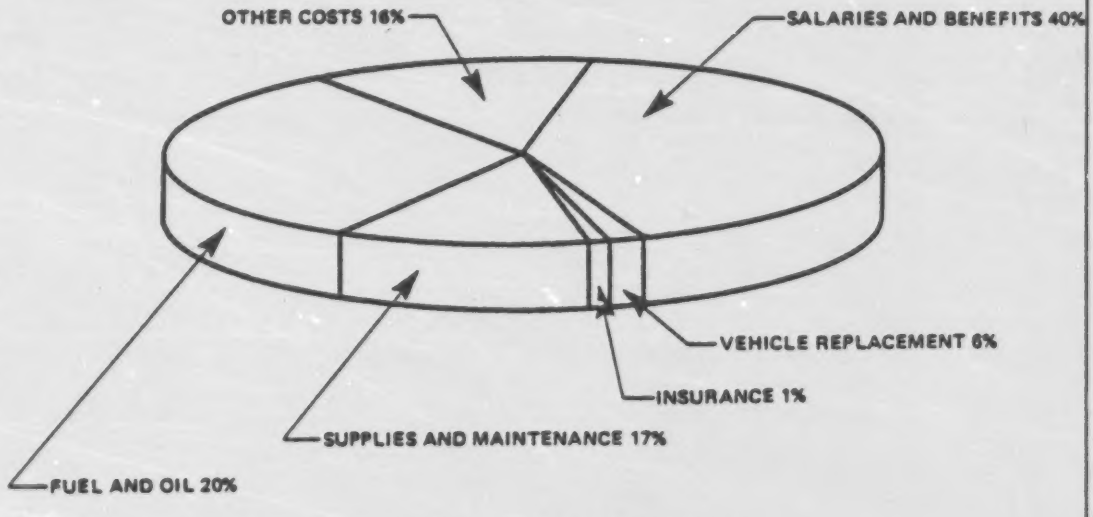
A COMPARISON OF FUEL COSTS TO OTHER PUPIL TRANSPORTATION EXPENSES



SOURCE: BASED UPON NATIONAL CENTER FOR EDUCATION STATISTICS, U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, 1975 AND STATE DATA

*Since 1975 - The transportation dollar distribution is changing rapidly ie. increasing in fuel and oil, supplies, maintenance & insurance--decreasing in salaries & benefits. Although vehicle costs have skyrocked, the number of replacement units has decreased.

8. WHAT IS A FUEL ECONOMY MANAGEMENT PROGRAM?

Fuel is an easily identifiable operating expense. Fuel economy is a measure of the pupil-miles-per-gallon that each school vehicle obtains from the fuel that is consumed--school buses and school district automobiles. It represents a measure of the effectiveness of a school district's service to provide efficient and safe pupil transportation for the least amount of money using the minimum amount of fuel. School bus fuel economy is obtained by transporting the maximum allowable number of pupils the shortest necessary distance in a vehicle offering the greatest miles-per-gallon for the task.

A fuel economy management program is an individual strategy--individual for each school district--consisting of identifying goals for reducing fuel use, deciding on how to implement them, and devoting the time and effort necessary to achieve results. It is based upon sound business practices.

The success of a fuel economy management program depends upon people--administrators, management, staff, bus drivers, shop personnel, and students. Everyone can and should contribute. Take advantage of the resources that are available. The energy of people is immense. It is generally too vast to be curtailed and immeasurable, if inspired. Use this available energy to initiate a fuel economy management program to increase the overall effectiveness of pupil transportation in your school district.

9. HOW IS A FUEL ECONOMY MANAGEMENT PROGRAM ORGANIZED?

A sound organizational plan is basic to success. The fuel economy management program should be organized within existing management functions. Place emphasis upon identifying goals and objectives, policies, fuel saving practices, responsibilities, and authorities to achieve better fuel and cost management. Involvement, commitment, communication, feedback, results measurement, and teamwork are key elements in your program:

1. Designate an individual to have the responsibility for heading the program.
2. Identify school district fuel saving goals.
3. Review policies, programs, and practices that affect pupil transportation fuel use and costs.
4. Develop recommendations to save fuel by performing tasks more efficiently.
5. Evaluate fuel saving measures that look promising.
6. Develop a plan to carry out the recommendations that appear to be the most promising for meeting the district's fuel saving goals.
7. Obtain administration endorsement and total commitment to carry out the plan.
8. Initiate the efforts required to implement the program; don't forget public relations activities and communication of the district's goals to the community.
9. Implement management controls to achieve the district's goals and objectives; measure and evaluate results during program operation.

10. WHY ARE ADMINISTRATIVE POLICIES IMPORTANT IN SAVING FUEL?

Policies provide the setting for obtaining fuel savings--they represent the mechanism for achieving goals. No one person or department can carry out the entire program successfully. It requires teamwork. Policies offer a framework for directing the team. Examples of fuel saving policies that can be investigated include:

___ Coordinate school calendars, (e.g., dates along with start-and-dismissal times), among all schools serviced to increase pupil transportation servicing effectiveness.

___ Stagger hours, when practical to do so, based upon bus load levels.

___ Consolidate special education start-and-dismissal times to coordinate more closely with the school program.

___ Increase the walking distance to school and bus stops. Strictly enforce walking distance regulations.

___ Avoid unnecessary service. Combine field and athletic trips. Use public mass transit when feasible for older students.

___ Initiate programs that encourage students and staff to walk to school or ride bikes.

___ Develop fuel economy incentives.

___ Offer assistance to carry out the fuel economy program. Provide skills and resources--people, computer access, materials--to assist the transportation department to increase service efficiency.

___ Establish maximum distances and department budgets for school travel.

___ Consider a maximum miles-per-hour speed limit for all school vehicles. Enforce it.

___ Promote actions that save fuel.

___ Encourage the purchasing of equipment that saves fuel.

11. WHAT CAN BE DONE TO SAVE FUEL IN VEHICLE OPERATION?

Operation offers many areas for increasing fuel economy.

Consider the following recommendations for your program:

(1) Keep accurate records on vehicle fuel consumption and use this data in making transportation servicing, maintenance, and purchasing decisions.

(2) Use "zone loading" practices with stops spaced as far apart as feasible and safe to do so.

(3) Use the smallest practical vehicle for long distance light-load runs.

(4) Match equipment to service needs; don't use a 66 passenger bus when a 30 passenger bus will do the job.

(5) Reduce "dead heading." Use this as a training period for new drivers.

(6) When drivers have split shifts, consider parking near their homes between runs when feasible to avoid "dead heading."

(7) Consider the use of satellite bus parking stations to avoid "dead heading."

(8) Scrutinize current bus routes. Look at how many avoidable stops the buses are faced with--stops that result in fuel waste while the vehicle is idling in congested traffic.

(9) Encourage and promote good driving habits--starting and stopping smoothly, turning off the ignition when the bus will be stopped for more than one minute, avoiding full throttle, driving at steady speeds, and looking far enough ahead to avoid dangerous and fuel wasting situations.

(10) Reduce warm up periods. Let drivers dress warmer and drive slower until the engine is heated.

(11) Route buses to stay on main roads as much as possible.

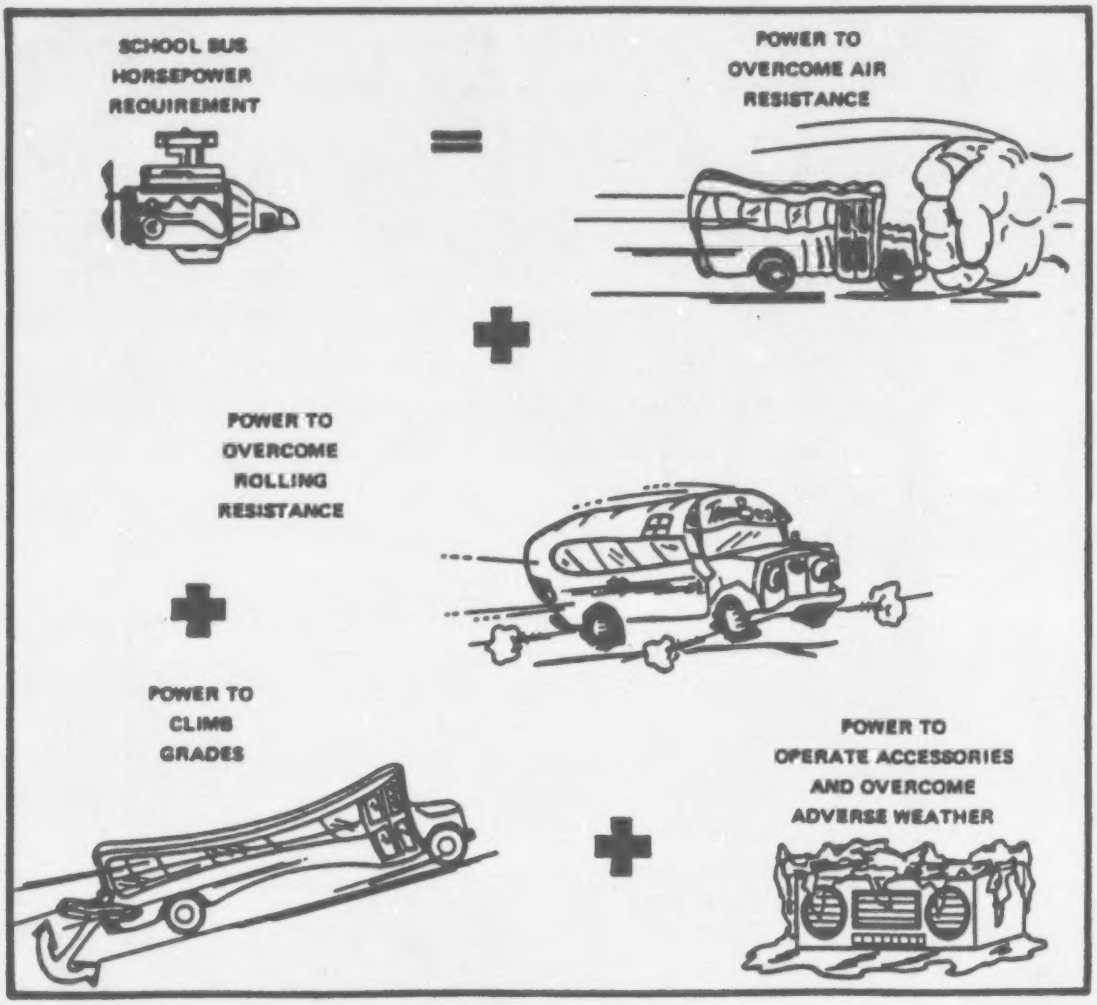
(12) Establish good preventative maintenance program. Provide record system which will determine best tune up cycles, to generate most fuel efficient engine performance.

12. TEN MOST FREQUENT OPERATIONAL PRACTICES THAT CREATE EXCESSIVE ENERGY DEMANDS

1. Extended vehicle warm-up
2. Failure to notify mechanic when vehicle requires repair
3. Idling engine excessively
4. Excessive speed
5. Improper use of accelerator
6. Failure to properly inspect vehicle before starting route
7. Unauthorized stops
8. Improper use of clutch
9. Improper use of brakes
10. Failure to maintain proper tire pressure

13. HORSEPOWER AND FUEL ECONOMY

Fuel economy is related to the horsepower needed to power a school bus and the efficiency of the vehicle's engine that provides the power. The total power to operate a school bus is dependent upon the following basic elements:



14. OVERCOMING AIR RESISTANCE

Air resistance is a force that is exerted on the school bus when it is being driven. Engine horsepower must overcome this resistance--the greater the resistance, the more horsepower that is needed to do the job. Horsepower is obtained from fuel combustion in the engine. Additional horsepower demands result in the consumption of greater amounts of fuel.

A streamlined vehicle offers advantages in overcoming air resistance. The forces are reduced considerably as the school bus moves more smoothly through the air.

Vehicle speed is a major factor in air resistance. A vehicle traveling at 25 miles-per-hour will require only one-eighth of the horsepower to overcome wind resistance as compared to the same vehicle traveling at a speed of 50 miles-per-hour. As a rule of thumb, doubling school bus speed increases the horsepower needed to overcome air resistance by a factor of 8. That's why high speeds result in greater fuel consumption. The type of vehicle you drive and how you drive greatly affect fuel economy.

15. OVERCOMING ROLLING RESISTANCE

As a tire rolls, it flexes. This results in a heat buildup or resistance which must be overcome. The engine has to work harder to overcome this resistance. The greater the resistance, the more fuel that is required by the engine to overcome it.

Road conditions affect rolling resistance. U.S. Environmental Protection Agency studies have shown that a gravel road can reduce fuel economy by as much as 35 percent. This means that the school bus that obtains 7 miles-per-gallon on good pavement can get as little as 4.5 miles-per-gallon when it is driven on a gravel road.

Keeping tire inflation pressures at recommended levels will reduce rolling resistance. This practice can extend tire life, offering more miles-per-tire, and increase vehicle fuel economy.

Steel-belted radial tires are constructed so that they offer less rolling resistance. Such practices as the use of radial tires and route planning to keep buses on good roads are important in obtaining greater fuel economy from the district's fleet.

OVERCOMING ROLLING RESISTANCE
WHERE YOU DRIVE AND HOW YOU DRIVE
IS IMPORTANT IN MINIMIZING ROLLING
RESISTANCE EFFECTS

16. GRADES AND HILLS

ROUTE TO INCREASE VEHICLE FUEL ECONOMY

Hills also have an effect on fuel economy. A 36,000 pound bus traveling at 50 miles-per-hour will increase its fuel consumption by almost 30 percent to climb a continuous 1 percent grade. This means that the bus offering 7 miles-per-gallon under the best of conditions will only get 5 miles-per-gallon when it climbs this small grade. Fuel economy suffers more at lower speeds when climbing grades. This is another reason why route planning and driving skills are important in increasing fuel economy.

WEATHER EFFECTS

17. DRIVE SLOWER IN INCLEMENT WEATHER

Cold weather reduces a vehicle's fuel economy. Lubricants do not flow easily; the vehicle's engine cannot reach its rated efficiency. Fuel economy will drop off about 2 percent for each 10°F drop of temperature.

Winds also reduce fuel economy. When driving into a strong headwind or crosswind, the school bus is further penalized and its fuel economy is decreased.

ACCESSORIES

18. USE ACCESSORIES THAT CAN HELP TO SAVE FUEL

Accessories such as the engine fan and compressor require additional power from the engine; thus, they make additional power demands which lead to greater fuel consumption. A fan clutch is an example of options that are available to reduce fuel economy penalties. The fan clutch cuts the horsepower drain from the fan when it is not needed for cooling--this occurs about 95 percent of the time under normal driving operation.

19. PUTTING IT ALL TOGETHER

Many other factors are also important in getting increased fuel economy. Engine performance is obtained by selecting the smallest and most efficient engine for the job and maintained by placing emphasis upon preventive maintenance programs to keep the efficiency high. Vehicle size, design, and weight, along with how it is maintained are important. What you drive, where you drive, when your drive, and how you drive affects fuel economy. The combination of the wrong set of conditions--high speed, excessive idling, bad weather, poor roads, rough terrain, excessive starting and stopping, underinflated tires, pumping the gas pedal, and poor shifting habits -- can increase a school bus' fuel useage by as much as 100 percent or more. On top of this, if the vehicle has not been maintained properly to achieve its maximum efficiency under the best of conditions, fuel useage further suffers -- maybe as little as 10 percent or as much as another 100 percent, depending upon the engine's condition.

Operating for fuel economy means to give consideration to all of the factors mentioned. Dollars are just too scarce to throw them out the vehicle's exhaust thru additional fuel purchases. Remember these tips and make sure the district's transportation staff understands them. Every member of the transportation organization plays an important role in increasing the fleet's pupil-miles-per-gallon.

Consult the ESTEEM Handbook, "Encouraging School Transportation Effective Energy Management," for further tips to increase fuel economy and for guidance in implementing fuel economy management--a management program that offers fuel and dollar savings to every school district.

A PROFESSIONAL BUS DRIVER KNOWS ALL HE CAN ABOUT HIS VEHICLE, ROUTE, AND EQUIPMENT.

20. EMPLOYING PROVEN DRIVING AND INSPECTION TECHNIQUES TO CONSERVE ENERGY

DRIVING TECHNIQUES

1. Do not exceed posted speed limits

   Depending on vehicle configuration up to 30% reduction in fuel consumption can be made by observing posted speed limits.

2. Avoid fast acceleration and hard braking

   Maintain a steady throttle setting for maximum economy. Anticipate stops and brake smoothly.

3. Turn engine off at extended stops and layovers

   An engine that isn't running uses no fuel.

4. Shift gears at proper speed

   Revving beyond the shift point and lugging the engine are both wasteful and can shorten engine life.

5. Anticipate conditions ahead and begin to react sooner

   A good defensive driver maintains vehicle control and avoids panic stops or hard braking. A smooth, constant operation saves fuel.

6. Observe the following "don'ts" when driving:

   A. Don't depress clutch until engine stall speed is reached so engine can assist in stopping the bus.
   B. Don't drive with your foot resting on the brake pedal.
   C. Don't race engine during warm-up.
   D. Don't over-speed engine at any time.
   E. Don't allow engine to operate beyond established oil change and maintenance intervals.
   F. Don't attempt to operate engine when oil pressure is low, temperature is high, or ammeter indicates a continuous discharge.
   G. Don't skip gears when upshifting or downshifting.
   H. Don't release the clutch quickly or ride the clutch.
   I. Don't hold the bus on a hill by slipping the clutch.

21. INSPECTION

1. Conduct pre-starting inspections daily and report vehicle malfunctions to the mechanic (hear, see, smell, feel)

   A well maintained vehicle is a must in order to operate efficiently. Report all problems regardless how minor in nature.

2. Check bus tail pipe during pre-starting inspection

   Vehicle's tail pipe (gasoline engine) should be pale gray. If it is black, check choke operation and/or refer to the mechanic.

3. Check tail pipe smoke after the run

   Smoke from a hot engine indicates possible engine problems. Refer to the mechanic.

4. Learn to read smoke signals from diesel engines

   Blue smoke: Indicates that the engine may be loosing power and thus may be burning more fuel.

   Black smoke: Indicates the presence of unburned carbon, too little air for complete burning of the fuel.

   White or grey smoke: During normal operation indicates the engine is misfiring and wasting fuel.

5. Check gasoline tank for possible leaks

   Energy conservation begins with accounting for all fuel placed in the bus. Record mileage and all fuel entries.

SPECIAL NOTE TO DRIVERS

Energy conservation is a team effort. Each driver must gear his attitude and behavior toward solving the energy crisis through conservation efforts. As a driver you should:

1. Observe all rules and regulations adopted by your school district.
2. Carry out assigned duties quickly and efficiently.
3. Direct student rider toward energy conservation.
4. Operate buses safely and efficiently.

22. TRAIN PERSONNEL TO ACHIEVE INCREASED FUEL ECONOMY

> "A GOOD MANAGER IS A MAN WHO ISN'T WORRIED ABOUT HIS CAREER BUT RATHER THE CAREERS OF THOSE WHO WORK FOR HIM."
>
> H. S. BURNS, PRESIDENT
> SHELL OIL COMPANY

Equipment is carefully designed to perform specific tasks. Yet achieving its potential to perform the task efficiently is dependent upon those who operate it. A purpose of personnel training is to make sure that they know how to obtain maximum performance from their equipment. Evaluate the opportunities for increasing personnel skills. This is an important second step in obtaining increased fuel economy.

QUESTIONS TO BE ADDRESSED	POTENTIAL SOLUTION	DISTRICT PRIORITY
Do drivers recognize the factors that lead to more miles-per-gallon?	Driver Re-education	
Do drivers have a thorough knowledge of defensive driving practices which result in greater fuel economy?	Driver Fuel Economy Training	
Are mechanics familiar with equipment that can pinpoint and correct engine efficiency problems?	In-Service Training Schools	
Are mechanics making use of specialized services that exist to increase the effectiveness of the maintenance program?	Conferences And Workshops To Increase Knowledge	
Can operating costs be identified if bus routes or vehicle use are changed?	State-Of-The-Art Planning Tools And Professional Seminars	
Can the location of every bus be pinpointed at any time?	Dispatcher Training	
Does it pay to modernize the fleet or replace equipment?	Fuel Economy Management	
Do operation records indicate the level of performance of each vehicle in the fleet?	Records Management	

23. PURCHASE TO OBTAIN GREATER FUEL ECONOMY

In an era of extremely tight budgets, the school district must obtain the most benefit from each dollar that is spent. Each major equipment purchase must be based upon sound economic principles. It is not necessary for the purchasing manager to be a master mechanic or engineer, but he must know what contributes to fuel savings and have an appreciation of the equipment suited for the operation. The following table offers criteria that lead to better purchasing decisions. The use of these criteria should be a part of every purchasing decision.

SELECTION CRITERIA	CRITERION DEFINITION	DISTRICT PRIORITY
SERVICE	The vehicle should be designed to do the job that it is purchased for--no more and no less.	
QUALITY	The vehicle should provide economical, trouble-free service over a relatively long life-expectancy.	
RELIABILITY	The vehicle should be constructed to allow for necessary preventive maintenance to be performed readily and relatively easily.	
FUEL SAVINGS	The vehicle should offer fuel and oil savings.	
COST	Considering all the above factors, purchase of the vehicle should offer the district a good Benefit-Cost ratio.	

The development of purchasing specifications to obtain greater fuel economy is an important third step in achieving more pupil-miles-per-gallon.

24. OPERATE FOR FUEL ECONOMY

Pupil transportation has many complexities; it offers numerous challenges for increasing efficiency. Each area of the operation is important and contributes to overall program effectiveness.

Review the elements within the transportation operation to determine if they can be performed better. There is always room for improvement. Take advantage of modern practices and equipment that are available to improve performance.

TRANSPORTATION OPERATIONAL AREA	IMPORTANT QUESTIONS TO BE ADDRESSED IN EACH OPERATIONAL AREA
ORGANIZATION	o Is the current organizational plan served by good channels of communication? o Is the workload excessive for the staff to properly perform?
ROUTING	o Are bus loads and schedules analyzed? o Is a comparative analysis performed? o Are vehicles properly matched to the route?
SCHEDULING	o Do guidelines govern vehicle use? o Is equipment used for its intended purpose?
DISPATCHING	o Is the dispatcher sufficiently advised of traffic problems in advance? o Can the dispatcher reschedule vehicles that are on their runs?
LOADING & UNLOADING	o Can the distance be lengthened between student pick up points?
VEHICLE PERFORMANCE AND COST CONTROLS	o Is a periodic analysis of vehicle performance made? o Is historical information available on each vehicle in the fleet?
MAINTENANCE	o Is maintenance equipment adequate to support servicing requirements? o Is management by exception practiced? Do the jobs get done?

25. MAINTAIN FOR FUEL ECONOMY

Dollars spent to upgrade the maintenance program are among the most important in obtaining increased fuel economy. There are no compromises in effective maintenance from a standpoint of safety or fuel economy. If the district's program is not adequate, it will penalize all other areas of the operation because the potential for achieving fuel savings will be diminished.

SOME FINAL COMMENTS

Take advantage of what other school districts are doing to increase the performance of their fleets. Ask the following questions?

- o When was the last time that district personnel attended a workshop on fuel economy?
- o How often does the staff communicate with other districts to exchange fuel economy information?
- o Does the administration promote these exchanges?
- o Does the driver training program contain a unit on fuel economy?
- o Are in-service training programs offered for the staff?
- o Does management recognize the benefits of computerized routing and scheduling?
- o Does management recognize why specific problems have arisen and how they can be resolved?

Address each of these areas to improve fuel economy. As the late President Kennedy stated in a message to Congress in 1961 "The human mind is our fundamental resource." Capitalize upon it in your school district.

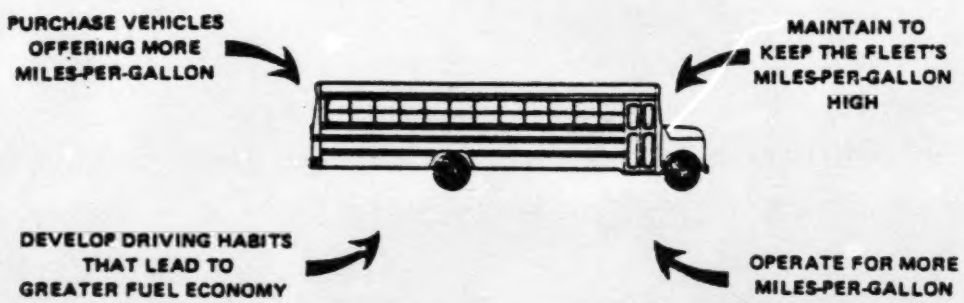
26. WHAT ELSE CONTRIBUTES TO BETTER FUEL ECONOMY?

A preventive maintenance program that emphasizes maximum efficiency from each bus in the fleet is a very important part of the fuel economy program. A sound program which takes advantage of state-of-the-art equipment and fuel saving practices to maintain the school bus fleet offers numerous benefits. Many efforts can increase fuel economy. Only a good preventive maintenance program can insure that this fuel economy is maintained on a day-to-day basis.

Purchase with fuel economy in mind. Maintain the fleet using equipment that allows mechanics to keep efficiency high. Instill an environment that supports close coordination between school bus drivers and the maintenance staff. Correct problems now, do not put them off.

Re-educate drivers when necessary to use fuel saving techniques. Make sure that fuel economy practices are followed by all drivers. This can be done by keeping track of each vehicle's performance--fuel and oil consumption, miles driven, and pupils transported.

Purchase, plan, operate, drive, and maintain for better fuel economy. These practices allow the district to get the most out of each dollar spent for pupil transportation.


PURCHASE VEHICLES OFFERING MORE MILES-PER-GALLON
MAINTAIN TO KEEP THE FLEET'S MILES-PER-GALLON HIGH
DEVELOP DRIVING HABITS THAT LEAD TO GREATER FUEL ECONOMY
OPERATE FOR MORE MILES-PER-GALLON

27. FUEL AUDIT SYSTEM

What is a fuel audit?

- Instrument or balance sheet showing how and where fuel is used within the transportation operation.

Do you have a fuel audit system?

Who should establish a fuel audit system?

- Every school district operating a fleet, regardless of size
- Board owned and contract

How to establish fuel audit system:

- Designate <u>one person</u> as fuel coordinator

  <u>Responsibilities</u>

  - Keep updated on energy outlook
  - Keep fuel supply records
  - Keep administration informed on energy outlook
  - Establish and administer effective record systems for documenting fuel utilization
  - Establish reporting procedures
  - Analyze fuel availability and current operational needs
  - Set up contingencies for time of short fuel supply
  - Establish action plans to conserve fuel utilization

What records to include in fuel audit system:

- Suppliers (name, address, telephone)
- Bulk storage data (capacity)
- Delivery dates and practices
- Current fuel consumption
  - By vehicle and MPG
  - Daily
  - Monthly
- Fuel available at end of each month
  - Compare with useage records
  - Check tank supply
- Fuel consumption of past two years
  - By vehicle and annual miles
  - Monthly and total for year

Who will be required to keep records?

Drivers (each time fuel is entered)

- Gallons
- Mileage
- Spillage
- By vehicle

Mechanics--each time fuel is used in maintenance vehicles
- Gallons and tenths
- Mileage
- Spillage
- Vandalism
- By vehicle

Other (specify)
- Gallons and tenths
- Mileage
- Type vehicle

Placing a fuel audit system in operation.

- Stress keeping accurate operational records (without accurate records, management capabilities cannot exist)
- Know how much fuel is used. How much is accounted for and how much efficiency is derived from fuel expenditures.
- Evaluate current maintenance procedures. Determine individual operating cost per vehicle for current month and year-to-date. Evaluate fuel use in comparison to miles traveled.
- Make comparison base on previous experience
  - By vehicle
  - By miles traveled

Set up action plans to conserve fuel consumption

- Drivers
- Student riders
- Parents
- Mechanics
- General public

Action plans must be designed to change attitudes toward saving fuel

Start with <u>School Bus Riders</u>:

- Be on time for bus
- Walk to consolidated stops
- Pay attention and get off promptly at stops
- Move quickly to seat when loading
- Line up and board bus quickly
- Dress properly for weather conditions

<u>Parents</u>:

- Encourage to have children at stops on time
- Reinforce energy saving techniques in the home (attitude development)
- Dress children properly for weather conditions
- Call drivers or supervisor rather than waiting at bus stop to discuss problems
- Know transportation rules and regulations and require children to observe all rules

Bus Drivers

- Be on time for stops
- Employ fuel saving driving techniques
- Make only approved stops
- Dress properly
- Work with bus riders to conserve fuel
- Record fuel useage daily--be accurate
- Report maintenance problems promptly to mechanic for repair

Mechanics

- Properly maintain vehicles
- Use proven fuel saving devices and additives
- Keep accurate operational records

The fuel audit coordinator must review and update action plans when required and introduce adjustments required to save additional fuel.

Meet periodically with personnel to revise fuel saving techniques.

SAMPLE

FUEL AUDIT BALANCE SHEET

Storage Capacity _____ Supplier _____ Phone _____

Note: All fuel Expressed in gallons and tenths Cost/gallon _____ Status _____

A. Fuel Supply (beginning of month) _____

B. Fuel purchased _____ (gallons)

C. Fuel purchased _____ (gallons)

D. Total Fuel Supply for Month (a+b+c) _____

Fuel Useage

1. Buses _____
2. Maintenance vehicles _____
3. Spillage _____
4. Vandalism _____
5. Other (specify) _____

E. Total Fuel Used (1+2+3+4+5)

F. Fuel Supply (end of month) (storage tank reading) _____

G. Fuel supply (end of month) (A-E) _____

BUS #	FUEL	MILES TRAVELED	MPG	SPILLAGE	
1.					SUB TOTAL

MAINT. VEHICLES	FUEL	MILES TRAVELED	MPG	SPILLAGE	
2.					SUB TOTAL

OTHER VEHICLES	FUEL	MILES TRAVELED	MPG	SPILLAGE	
3.					SUB TOTAL

Vandalism _____

other (specify) _____

4. Sub Total _____

5. Total (1+2+3+4) _____

106

107

28. HOW TO MOTIVATE "PEOPLE POWER"?

Personnel morale, motivation, growth, and development are important parts of obtaining and maintaining increased fuel economy. Recommendations that lead to fuel savings include:

(1) Promote an environment of self-improvement. Offer incentives for staff education and skill development.

(2) Keynote performance in the staff.

(3) Introduce "competitive driving" for maximum fuel economy.

(4) Include a unit on "fuel economy" in the district's driver training program.

(5) Send mechanics to "engine tune-up" schools, workshops, and seminars to keep up with the state-of-the-art.

(6) Initiate a "more-miles-per-gallon" campaign; promote it.

(7) Hold joint workshops with drivers and maintenance personnel on a frequent basis to share fuel economy knowledge.

(8) Hold workshops with other districts. Take advantage of what others are doing to save fuel and reduce expenses.

(9) Request information from drivers in route planning. Provide incentives for ideas that can save fuel.

(10) Obtain staff and teacher participation in your fuel economy program. Get them involved; solicit ideas from them.

(11) Get school organizations involved in the program. Have the science club or auto shop conduct a contest to promote fuel saving ideas. Have students design posters which can be used to promote the program. Place these posters in buses and throughout the school and community.

(12) Use the PTA as a medium to promote the district's fuel economy program throughout the community.

(13) Have members of the staff, faculty, student body, and PTA be a part of the team. Let them participate in program planning and implementation.

29. CAN ALL SCHOOL DISTRICTS TAKE ADVANTAGE OF A FUEL ECONOMY PROGRAM, EVEN SMALLER ONES?

The battle against wasted fuel is being fought by large and small bus fleet operations in school districts of all sizes and by private operators. "More miles-per-gallon" is a national goal--a goal that can translate into saved dollars for every school district.

Fuel economy savings have significance for every pupil transportation operation. The transportation department that services many pupils with a large fleet may obtain large dollar savings.

If $58,000 is invested in fuel saving equipment having a 7-year life that could return fuel and maintenance cost savings of $15,000 annually, this investment would offer a return on investment of 25.9 percent and a payback period of 3.9 years. The equipment would pay for itself, based upon these savings, and offer the district additional dollars that could be used for other needs. Similar types of savings, proportionate to scale, are available to smaller fleets. Evaluate opportunities for obtaining savings in your school district. Consider fuel savings, reduced maintenance costs, labor savings, and other benefits that can be obtained from actions taken to increase fleet performance.

FUEL ECONOMY DOES NOT NECESSARILY MEAN TO RUSH OUT AND INVEST. ALL TOO OFTEN SCHOOL DOLLARS ARE TOO SCARCE. FUEL ECONOMY IS OBTAINED BY DEVELOPING AND IMPLEMENTING SOUND DECISION CRITERIA. WHEN YOU MUST SPEND DOLLARS, MAKE SURE THAT YOU'RE OBTAINING THE BEST RETURN FROM THEM. ALSO LOOK AT EQUIPMENT IN THE FLEET THAT IS OFFERING LOW FUEL ECONOMY. DETERMINE IF THE COST TO UPGRADE IT CAN SAVE THE DISTRICT DOLLARS.

ANONYMOUS

30. WHAT STEPS SHOULD BE TAKEN TO INITIATE THE DISTRICT'S PROGRAM?

The first step is to make a commitment that fuel is going to be saved in school transportation. Plan a "more miles-per-gallon" program. Get everyone involved, including students and parents. Saving fuel can be exciting. It is rewarding. Identify fuel saving goals. Develop a plan of actions for achieving these goals:

- Provide incentives for increased fuel economy.
- Chart fuel economy; let everyone know who the best drivers are and give them recognition.
- Get the PTA involved to promote the program in the community.
- Involve school organizations; initiate student projects for ideas on increasing fuel economy.
- Prepare fuel economy posters. Place them on buses. Instill fuel economy competition.
- Promote the program throughout the community.
- Publicize program results for the community to see.

See if it is necessary to update policies to help the school district save fuel. Agree upon practical goals that can save fuel, establish programs to carry out the plan, and get everyone involved in its implementation.

31. MEASURING PURCHASE BENEFITS

Problems that arise in using the payback period as an indicator of investment value include: all proceeds received before the payback period are treated as equals, all proceeds received after the payback period are ignored, and the technique considers future year dollars to be the same as present year dollars. This is not true. A dollar held in hand today is worth more than the promise of a dollar in the future. Inflation and interest costs must be given consideration in the economic analysis.

Benefit-cost analysis, making use of discounted cash flow measures to show the time value of money, should be used to provide a more comprehensive measure of investment performance. Present Value (PV) analysis offers one such basis for investment evaluation as shown below using the tables.

$$\text{Present Value} = \{\text{Annual \$ Savings}\} \{\text{Present Worth Factor Value Of Money Based Upon Time And Discount Rate}\}$$

As an example in the use of this technique, assume your district is considering the purchase of a new school bus that is to be driven 15,000 miles annually. The district compares diesel versus gasoline powered vehicles and finds that annual fuel savings of $550 and maintenance cost-savings of $720 can be obtained from the diesel-powered bus for a premium or additional first cost of $4,500. The present value of the net annual savings, assuming a discount (cost of money) factor of 9 percent over a 10 year period is $8,150.

$$\text{Present Value} = (\$550 + \$720) \quad (6.4177) \quad = \quad \$8,150.48 \text{ or } \$8,150$$

The benefit-cost ratio for this purchase is 1.81, a profitable investment. It returns $1.81 for each $1 invested over the 10-year life of the vehicle.

32. INVESTMENT BENEFIT-COST ANALYSIS

The benefit-cost (B/C) ratio is computed by dividing the investment's present value by the first cost. In the previous example, the present value is equal to $8,150 and the first cost premium was $4,500. This results in a B/C ratio of 1.81. This analysis assumed that fuel prices would remain the same over the period of investment. This is not true as discussed below.

$$\text{Benefit/Cost} = \frac{\text{Present Value } (\$)}{\text{First Cost } (\$)}$$

Use the following equation to give consideration to future fuel cost increases.

$$\begin{Bmatrix}\text{Average Annual Fuel Cost Over Investment Period } (\$)\end{Bmatrix} = \begin{Bmatrix}\text{Average Fuel Price This Year } (\$/\text{Gallon})\end{Bmatrix} \begin{Bmatrix}\text{Fuel Price Increase Multiplier}\end{Bmatrix}$$

The fuel price increase multiplier is computed as follows:

$$\begin{Bmatrix}\text{Fuel Price Increase Multiplier}\end{Bmatrix} = \frac{(1+f)^N - 1}{f.N} \begin{Bmatrix}\text{Refer to Table for values}\end{Bmatrix}$$

where f = estimated annual fuel price increase (%)
N = analysis period (years)

Assuming fuel price increases of 15 percent each year in the example, the present value would be $11,788.

$$\begin{Bmatrix}\text{Present Value}\end{Bmatrix} = \left[\begin{Bmatrix}\text{Average Fuel Savings/Year}\end{Bmatrix} \cdot \begin{Bmatrix}\text{Fuel Price Multiplier}\end{Bmatrix} + \begin{Bmatrix}\text{Total Of Other Annual Savings}\end{Bmatrix}\right] \cdot \begin{Bmatrix}\text{Present Worth Factor}\end{Bmatrix}$$

$$= \left[\left\{(\$\ 550) \cdot (2.0304)\right\}^{+} \ (\$720)\right] \cdot \ (6.4177)$$

$$= \left\{\$11,788\right\}$$

A more realistic B/C ratio is computed to be 2.62, a very profitable purchasing decision.

$$\text{B/C} = \frac{\$11,788}{\$\ 4,500} = 2.62$$

PRESENT WORTH FACTORS FOR PRESENT VALUE ANALYSIS

LIFETIME (YRS.) N	DISCOUNT RATE (i) 3%	6%	9%	12%
1	0.9709	0.9434	0.9174	0.8929
2	1.9135	1.8334	1.7591	1.6901
3	2.8286	2.6730	2.5313	2.4018
4	3.7171	3.4651	3.2397	3.0373
5	4.5797	4.2124	3.8897	3.6048
6	5.4172	4.9173	4.4859	4.1114
7	6.2303	5.5824	5.0330	4.5638
8	7.0197	6.2098	5.5348	4.9676
9	7.7861	6.8017	5.9952	5.3282
10	8.5302	7.3601	6.4177	5.6502
15	11.9379	9.7122	8.0607	6.8109
20	14.8775	11.4699	9.1285	7.4694
25	17.4132	12.7834	9.8226	7.8431
30	19.6004	13.7648	10.2737	8.0552
35	21.4872	14.4982	10.5668	8.1755
40	23.1148	15.0463	10.7574	8.2438
45	24.5187	15.4558	10.8812	8.2825
50	25.7298	15.7619	10.9617	8.3045

BASED UPON PRESENT WORTH FACTOR = $\frac{(1+i)^N - 1}{i(1+i)^N}$

i = DISCOUNT RATE FOR THE UNIT OF TIME (N) IN YEARS.

FUEL PRICE INCREASE MULTIPLIER VALUES

PERIOD (IN YEARS)	PROJECTED ANNUAL FUEL PRICE INCREASE 5%	10%	15%	20%
2	1.0250	1.0500	1.0750	1.1000
4	1.0775	1.1603	1.2483	1.3420
6	1.1337	1.2859	1.4590	1.6550
8	1.1936	1.4295	1.7159	2.0624
10	1.2578	1.5937	2.0304	2.5959

WHERE
FUEL PRICE MULTIPLIER = $\frac{(1+f)^N - 1}{f \cdot N}$

f = AVERAGE RATE (%) INCREASE OVER TIME (N)
N = PERIOD OF ANALYSIS IN YEARS.

PURCHASING IS AN IMPORTANT PART OF FUEL ECONOMY MANAGEMENT.

PURCHASE WISELY.

34. WHAT RETURNS ARE YOU GETTING FROM YOUR TRANSPORTATION PURCHASING DOLLARS?

Follow sound business practices in purchasing. Recognize the benefits of fuel and dollar savings to the district and the community. Every dollar saved in pupil transportation means that one extra dollar is available for providing a quality education for the community's children.

The gambling casinos in Las Vegas and Atlantic City operate on a percentage basis and in games such as roulette will win at least 5 percent of the time. Percentages are also important in saving fuel.

Purchase for fuel economy. Equipment that reduces the fuel consumption of a school bus by 10 percent offers the school district a 10 percent savings on its fuel costs. The equipment may also offer additional savings in maintenance and operation. Purchase equipment which will help the transportation department obtain and maintain better fuel economy performance.

Sound economic criteria are important for evaluating fuel economy opportunities. Before any investment is undertaken, a measure of its profitability should be computed so that the investment's expected return to the school district can be compared to alternative investment opportunities that may exist. The following section deals with purchasing strategy that will save fuel.

PURCHASING TIPS

1. Purchase school buses that offer good fuel economy. The national average is 7.4 miles-per-gallon. Does your fleet obtain this fuel economy? More important, is it possible to purchase vehicles that offer even better fuel economy for your district's driving environment?

2. Use sound economic policy to evaluate purchases. Do not overpurchase. Match the bus to your servicing requirements. Give consideration to such factors as fuel savings, equipment service life, maintenance savings, and operating cost savings in evaluating purchases.

3. Purchase equipment that will help school bus drivers to drive for fuel economy. Consider using vehicle performance recording charts and alarms that indicate when hazardous or poor engine efficiency conditions exist. Find out what other school districts are doing to save fuel.

4. Consider options that offer fuel economy in your purchases. Diesel-powered engines, lower numerical rear-axle ratios, radial tires, speed-governors, temperature-modulated fans, and turbochargers are examples of fuel saving equipment. An automatic transmission can also save fuel (and maintenance costs) if the bus is driven by drivers unskilled in operating a manual transmission.

5. Purchase equipment that will allow the maintenance staff to do a better job in keeping the efficiency of the school bus fleet at its maximum potential.

6. Consider options such as 2-way radios. Their use may save the district many dollars in bus rescheduling. They are also invaluable in emergencies.

7. Purchase wisely and purchase for fuel economy.

36. IT'S TIME FOR COOL HEADS NOT HEATED DISCUSSIONS

Fuel economy performance (miles-per-gallon) is a yardstick of how well a bus is driven. Thousands of gallons of fuel are saved each year by school transportation departments that have become serious and professional about fuel economy. Increased fuel economy just does not happen--it requires skill--the skill to drive safely and save fuel.

There are certain factors that are beyond a driver's control. Yet, each school bus will offer a range of fuel economies--depending on how well the bus is maintained and driven. Where you drive and how you drive affects the fuel economy that can be obtained.

Get in the habit of keeping track of fuel economy, calculate it, and compare it during fill ups. Inform maintenance personnel when the vehicle's miles-per-gallon is decreasing. It may be time for a tune up or other corrective actions.

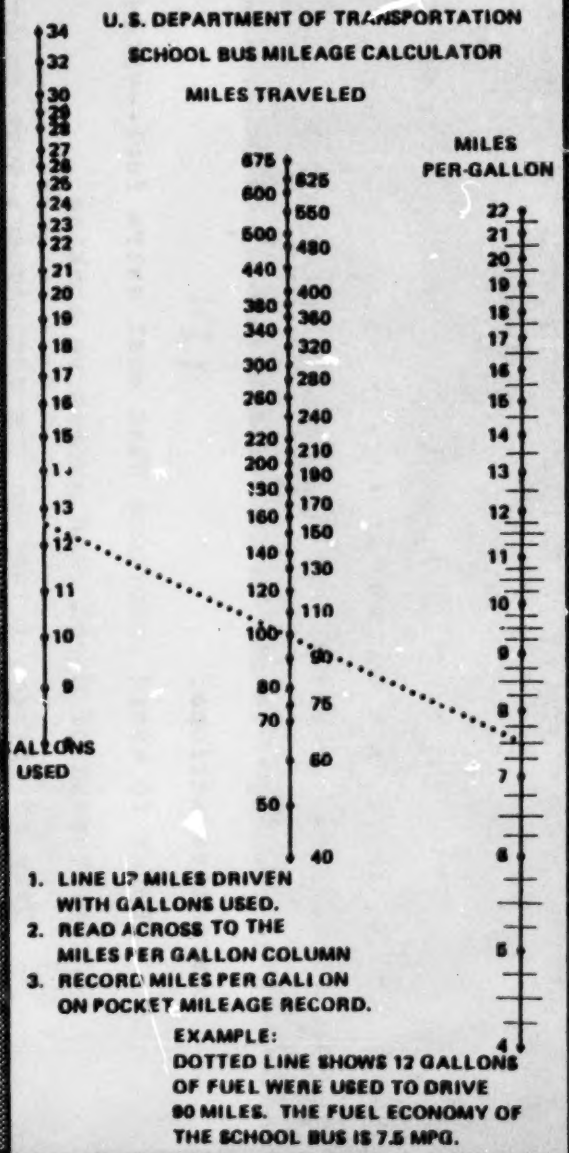
Learn to avoid practices that cost extra fuel--extended idling, bursts of speed, and excessive braking.

Take advantage of fuel saving techniques--some important ones are listed on the insert.

INCREASING YOUR MILES PER GALLON

Fuel economy savings are based upon percentages. The More skillful drivers can increase these percentages.

Record keeping is an important step in increasing fuel economy. Keeping track of the vehicle's miles-per-gallon indicates when it is time for a tune up or when equipment is not operating properly. Use the charts provided in the insert to keep track of your vehicle's miles-per-gallon. Record this information and use it as a yardstick for measuring school bus fuel economy.



POCKET MILEAGE RECORD

BUS NO._____ DRIVER_____

DATE	GALS	ODOMETER READING	MILES TRAVELED	MILES PER GALLON

POCKET MILEAGE RECORD

DATE	GALS	ODOMETER READING	MILES TRAVELED	MILES PER GALLON

U. S. DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20590

18 FUEL SAVING TIPS

1. CHECK THAT OIL, WATER LEVELS, AND TIRE INFLATION PRESSURE ARE PROPER EACH TIME YOU FILL UP.
2. GRADUALLY ACCELERATE THE BUS TO THE DESIRED SPEED.
3. DRIVE SLOWER WHEN THE ENGINE IS COLD.
4. LOOK AHEAD AND ANTICIPATE STOPS.
5. DRIVE AT STEADY SPEEDS. USE THE BRAKES AS LITTLE AS POSSIBLE.
6. ACCELERATE AND DECELERATE SMOOTHLY WHEN CHANGING SPEEDS.
7. PLAN YOUR TRAFFIC MOVES EARLY.
8. ADJUST THE VEHICLE SPEED TO THE ROAD AND WEATHER CONDITIONS.
9. SHIFT INTO HIGH GEAR AS SOON AS POSSIBLE, BUT DON'T LUG THE ENGINE.
10. TURN CORNERS SLOWLY AND CHANGE LANES SMOOTHLY.
11. TURN OFF THE IGNITION IF THE BUS IS TO BE STOPPED FOR MORE THAN 1 MINUTE.
12. DO NOT SPEED UP THE ENGINE BEFORE TURNING OFF THE IGNITION.
13. REDUCE IDLE ENGINE WARM-UP TIME.
14. DON'T START THE ENGINE UNTIL EVERYONE IS READY TO GO.
15. SMELL FOR TROUBLE, LOOK FOR TROUBLE, LISTEN FOR TROUBLE, FEEL FOR TROUBLE --REPORT ANY PROBLEMS IMMEDIATELY.
16. MAINTAIN PATIENCE, COURTESY, AND GOOD HUMOR.
17. KEEP ACCURATE RECORDS OF FUEL CONSUMPTION.
18. TRY AS MANY FUEL ECONOMY TECHNIQUES AS POSSIBLE TO INCREASE YOUR VEHICLE'S MILES-PER-GALLON.

38. CREDITS

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PROGRAMMED INFO ASSISTS OREGON FLEET

"A great way to run a business."

The transportation department of one of Oregon's largest school districts, Beaverton School District No. 48, has simultaneously reduced fleet maintenance and operating costs and simplified bus fleet record keeping by installing the modern equipment management system provided by Mainstem, Inc., of Princeton, N.J.

In addition to direct dollar savings, the Beaverton District is using monthly print-out reports from Mainstem to improve driver training, improve purchasing techniques, and boost employee morale.

Mainstem, Inc., a subsidiary of Cummins Engine Company, uses a computer memory bank to store, correlate and recall information on the maintenance operation of Beaverton's 101-bus fleet, and on the 49 other pieces of powered equipment used by the school district. These monthly reports are based on parts, labor, fuel and lubrication figures gathered by Beaverton's Transportation Department personnel and sent to the Mainstem computer center in Princeton each month.

The school district, one of the first in the nation to use Mainstem's equipment management system, is enjoying impressive benefits already. In less than a year, the district has reduced chargeable shop labor costs from $29/hour to $12/hour (a saving of more than 58-percent), has discovered a 5-cent-per-mile operating cost difference between different makes of buses of the same size class, and has significantly reduced the number of expensive overhauls.

"We had always kept records on the same items used by Mainstem—parts, labor, fuel, lubrication," reports Transportation Director John Barnes, "But we had no way of quickly summarizing the information in enough detail for it to do us much good. Now we're getting it back in a way that really tells us what is going on with the fleet. Mainstem knows how to program our information so we can get back a summary that is thorough, easy to read, and directly related to what we are trying to do."

Beaverton's fleet of 101 school buses includes 14 different classes of bus, ranging in size from mini-buses to seventy-passenger units. The fleet logs about 1.24-million route miles annually in a 57 square-mile district not far from the city of Portland. Over 75-percent of the 19,600 students in the district rely on the school bus system for transportation to and from school and school-related activities.

Practically any size school bus fleet can install the Mainstem system. Here's how it works:

1) An initial survey is made, at no cost, to make certain the system and fleet needs are compatible.

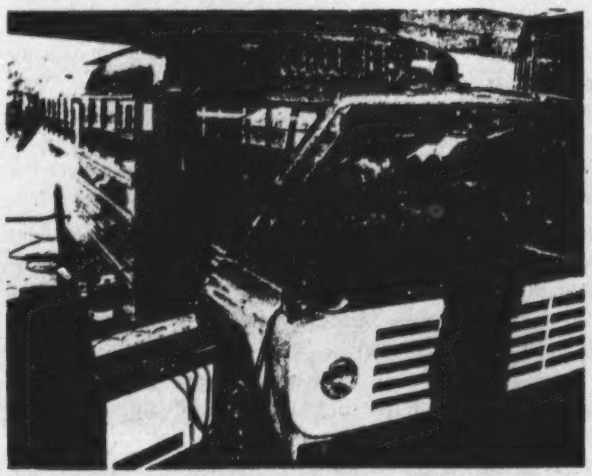
2) All necessary forms for recording data are provided.

3) A Mainstem fleet maintenance advisor is assigned.

4) Fleet personnel at all levels are trained to keep records.

5) Once operational, Mainstem provides a broad cost picture of fleet operation, including vehicle history, out-of-line conditions, component cost breakdown, cost per mile,

Gwen Pouillon (left) transportation department secretary, handles most of the record-keeping in a fraction of the time she formerly invested in traditional fleet operating and maintenance records. Reports John Barnes, transportation superintendent, "Her time savings alone just about pay for the cost of the Mainstem service."



Mainstem computer printouts on bus performance show equipment in need of tune-ups, thereby cutting fuel consumption and improving bus reliability. The growing record of bus operating costs now available to the Oregon school district will also enable it to specify the exact type of new equipment it requires.

warranty costs, and other data.

6) The fleet advisor uses these data – reported to him in understandable terms – to point out trouble spots and excessive costs. Then, based on the data, he recommends corrective action.

7) Historical cost comparisons are provided to measure the relative effectiveness of on-going operations.

According to Barnes, the district's biggest saving since using the Mainstem service has been through better utilization of shop labor. Nearly 50-percent of their time was often unaccounted for, with much of it consumed in such unchargeable activities as fueling, starting, and cleaning the buses, parts pick-up and tire repair. This had the effect of ballooning chargeable labor costs $29 per hour.

Now that accurate and fast allocation of labor costs is available, Barnes and shop foreman Joe Bates have been able to reduce this chargeable figure to a respectable $12 per hour, and to have the satisfaction of knowing that they are accounting for 97-percent of all shop labor time.

Bigger savings of a different type will be experienced in the months to come. The growing record of operating costs will help Barnes and school district personnel make better decisions on the purchase of new equipment for the district. Barnes has noted a 5¢/mile difference in the operating costs of two different makes of nearly identical buses, through study of Mainstem reports.

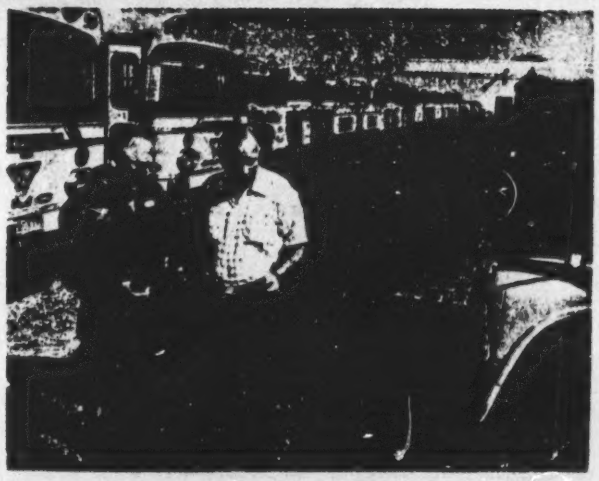
Savings in repair costs are now possible because the operating history of individual components is analyzed regularly. The service program for individal components is being adjusted to prolong component life and reduce highway breakdowns and unscheduled major repairs.

Already, reports are being used to pinpoint drivers whose need for additional driver training shows up in a greater-than average incidence of clutch, transmission, and rear-end problems. With printouts in hand within 10 days of each monthly reporting period, Barnes can give quick attention to a serious maintenance problem. For example, a bus with sky-rocketing fuel or oil consumption can be tuned-up or overhauled before a latent serious engine problem develops into a major repair job.

The burden of filing the reports so essential to the automated record keeping is shared by Bates and by Gwen Pouillon, the Transportation Department's secretary. Shop repair order forms that use check marks instead of written explanations, give Mainstem the information it needs to develop an analysis of the operating costs for each bus, and the accumulated costs of each of more than one hundred different parts or expensive items also are compiled.

"It takes half of Gwen Pouillon's time to handle these reports," says Barnes. "Previously she was spending all her time on a file of records that we could never digest or summarize. Her time savings alone just about pay for the cost of the Mainstem service."

The Mainstem equipment management system has now been extended to cover 49 other pieces of equipment operated by the school district's Transportation Department. These include powered lawn mowers, delivery vans, a dump truck and a motor grader. With a need to buy more powered lawn mowers, Barnes and Walt White, coordinator of auxiliary services, expect to use Mainstem's tabulation of



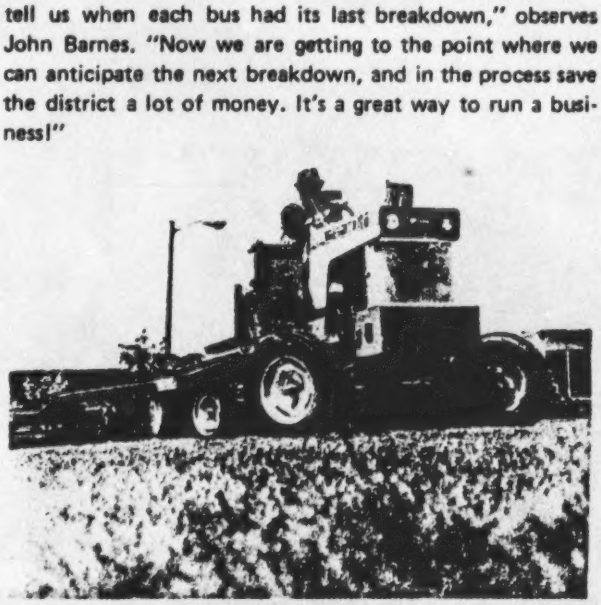
Joe Bates, shop foreman (left) and John Barnes, transportation superintendent, saw chargeable shop labor drop more than 50-percent and employee morale soar when Beaverton, Oregon School District, No. 48 switched its 86-bus fleet to the modern equipment management system provided by Mainstem, Inc. of Princeton, N.J.

their lawn mower maintenance and operating costs to clearly indicate which make is best adapted for the Beaverton District.

District Transportation personnel morale has improved, as shop personnel and drivers, aware that accurate records now show when they operate most efficiently and at lowest cost to the district, strive to improve their records month by month.

Perhaps as important as anything else is the management freedom this system provides Barnes and White. They are no longer tied to record keeping. The monthly summaries they receive give them the managing tools they need. They are able to make major equipment and personnel decisions based on complete and up-to-date information.

"In the past, our records could usually be relied on to tell us when each bus had its last breakdown," observes John Barnes. "Now we are getting to the point where we can anticipate the next breakdown, and in the process save the district a lot of money. It's a great way to run a business!"



The Mainstem fleet maintenance management system has been successfully extended by School District 48 to cover 49 other pieces of equipment like this power mower, and including a motor grader, dump truck, and delivery vans.

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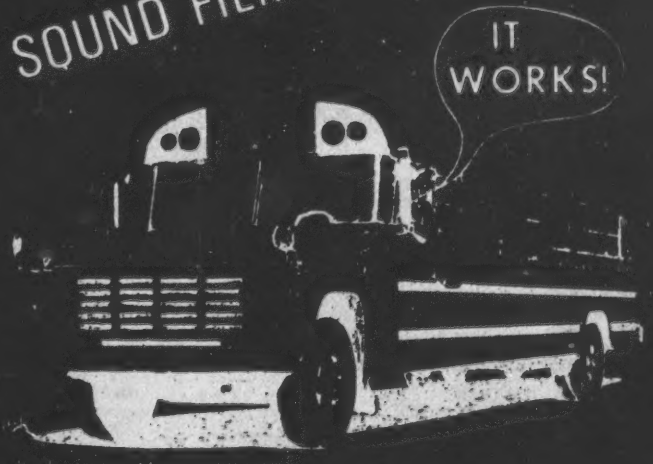

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☐ FATAL STOP! A STORY OF A PRE-TRIP INSPECTION
☐ ON THE ROAD: IN THE COUNTRY
☐ ON THE ROAD: IN THE CITY
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Your Order # Date Desired Alternate Date

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☐ PREVIEW: $15 for 3 days with check enclosed and return by the fastest method.

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(Organization, Dept. or School)

ADDRESS _____

CITY _____ STATE _____ ZIP _____

ATTENTION TO: _____ TELEPHONE NO. _____
(Must be completed)

I AGREE TO USE & PROVISIONS _____ _____
(Must be signed) (Title)

NOTE: Please request through AV Director or Superintendent if you are not authorized to submit purchase request form, please indicate if you want preview fee waived.

* ☐ Please indicate if you want preview fee waived

APPENDIX SIX

SOUTH LYON MICHIGAN COMMUNITY SCHOOLS

BY NORMAN SMITH

In 1974 we started a program to save fuel after the first energy crunch of 1973.

In the first year of the program, we saved 877 gallons of gasoline and traveled 11,457 miles further than the year before.

We did this by changing tune-ups from 16,000 mile intervals to 12,000 mile intervals. We also stopped all unnecessary idling. This measure alone saved 80 gallons of gas a week. Fleet fuel MPG in 1974 was 5.62.

In 1975 we watched driver habits and lowered shift points. Instead of revving engines to maximum shift points, we now shift at a maximum of 10 MPH in second gear, 20 MPH in third gear, and 30 MPH in fourth gear. Fleet fuel mileage in 1975 was 5.79.

In 1976 we reduced warm-up time and continued more training with drivers. As a result, fleet fuel mileage in 1976 was 5.84.

This program started in 1974 and now has become fully implemented and is showing 11% improvement. Fleet fuel mileage in 1977 was 6.37.

We would be pleased if our MPG stayed the same, considering every new vehicle we put on the road gets less miles per gallon than the one it is replacing. To continue improvement is an added plus.

For the 1979-80 school year, we are spending more time with driver operation. "Operation Featherfoot" shows drivers how to press on the gas pedal only enough to provide a smooth flow of power. It teaches them not to floor the pedal every time. Also, we are trying a new warm-up procedure to save more fuel.

Drivers start buses and then do their safety check, which takes about five minutes. They then shut the engine off and sit for five minutes. Then they take off on their run.

This five minute shutdown actually warms the engine faster than letting it run. Engine coolant is warmed by conducting heat from the combustion chambers. This seems to be working with no complaints from drivers.

We are planning to switch to diesel power on the next order for buses. After looking into this possibility, we find other fleets have doubled the MPG with diesels, and maintenance costs are down.

If our fleet was all diesel power, we could save 50,000 gallons of fuel in one year. We must go to diesel power. The cost of gasoline and the thought of using twice as much is staggering.

Alcona Community Schools
Lincoln, Michigan
BY WILLIAM RANDALL

Alcona Community Schools is a district encompassing some 420 square miles in the northeastern part of the state. School enrollment is 1310 children K-12, whereupon it is necessary to operate 20 buses daily.

The Superintendent's office was interested in finding ways to conserve energy and reduce costs in the district, so the transportation department took on the task of cutting fuel costs, without curtailing the home to school delivery of students. The district has adopted an Energy Conservation Policy with a goal of 10% reduction for '79-80.

Information from industrial firms showed us they had converted many of their trucks to Liquified Petroleum Gas from regular gas. Their figures indicated to us that the conversion costs were not excessively high, and with the lower costs of L. P. Gas, real dollar savings could be made both in fuel costs and maintenance costs.

We approached the Department of Education as to the legality of using L. P. gas on our school buses and found that the law neither prohibited nor condoned the use of this fuel. With this information on hand and the quasi-permission of the State Department of Transportation of the Department of Education, we made inquiries as to which company could help us accomplish our goal. We found that City Services Company and its area manager were very interested in finding a school district willing to convert to L. P. gas on school buses. The CITGO L. P. gas people aggressively took on our program as their project and sent two men, one technical instructor and a mechanic to our bus garage to instruct and install the necessary equipment for the conversion. During the two days our two buses were being converted we were visited by State Department of Transportation personnel also, so that they would be more knowledgeable on a first hand basis of our project.

The Mechanical work itself took about twelve hours per bus, although a part of this was spent in question-answer time for our mechanics in their learning process. The conversion basically required that we install a vacuum valve fuel converter and a L.P. gas carburetor. We also had to weld closed the exhaust part on the intake manifold and valve rotors. The mechanical conversion was relatively simple for our experienced mechanics. We also installed an L.P. gas tank, which is a thicker walled tank. There was no need to keep the regular gas tank on board, so they were dismantled from the bus. Our instructor advised us not to try to make a bus convertable

from regular fuel to L.P. gas by throwing a switch and using the alternate fuel. The engine is no longer able to accomodate regular gasoline.

Below are the actual costs which we paid to have our buses converted. Each bus costs the same amount.

Carburetor Kit	$269.00	
Labor - L. P. Gas Mech.	80.00	
Tubing and Hookups	75.00	
	$454.00	
1st L. P. Gas Tank	1.00	a second tank of 30 gallons would
	$455.00	cost us $252.

Our experience at the end of the first few weeks indicates that the motors are starting easy in the cold weather and the bus is providing a smoother and quicker acceleration. Spark plugs were changed at the end of a few weeks in order to install a colder plug. We noticed that after 1500 miles the plugs were exceptionally clean, which indicates to us that we have taken a positive step towards future maintenance savings. The cost of L.P. gas is about one-half the cost of regular fuel. This is a major cost savings from the first day of operation. The mileage per gallon has been slightly less than we customarily find on our other buses, which run at times 5 to 5.5. miles per gallon, depending on the type of bus, the number of stops, the driver and the age of the motor. Overall, however, we are able to see that the cost of conversion will be paid off before half of the school year has passed, and our real savings will be noticeable from thereon. If we wish to install a second 30 gallon fuel tank at any time we can. The cost is stated above and it would provide us with greater distance usage for out of town trips.

Attached you will note a comparative mileage report which we have kept to study our program. We converted our new pickup in the Transportation Department also, after an early analysis of costs. The pickup is used principally for bus emergency needs and winter snow plowing around the bus garage.

The fueling of the buses is similar to that of our regular buses. We were fortunate in being able to drive only one quarter of a mile to a bulk fueling station. The driver merely unlocks the pump hose behind the fence and twists the nozzle into the special tank insert. Two valves are turned on the pump and the L.P. gas flows. Meters on the pumps indicate when we are nearing our fill up point and a special release gauge sounds off when that point is reached. The bus fuel tank is never filled more than 85% capacity. The total process is simple, even though drivers are cautioned to wear gloves in handling the hose to the bus tank insert.

Our feeling at this time is that if L.P. gas remains at a cost considerably less

than regular fuel, and if we do economize on maintenance parts and labor we may convert additional buses next summer. Only time will tell if we convert the entire fleet over to L. P. gas. In the event we should decide to convert several buses, it will be necessary to install our own bulk storage tank at the bus garage for driver convenience. The Superintendent will make a recommendation to the Board at the end of this year and after analysis of the data generated.

GREENHILLS-FOREST PARK CITY SCHOOL DISTRICT
Cincinnatti, Ohio
BY HUGH PACEY

A. District and Fleet Statistics

1. District size = 7119 pupils - 13 square miles.
2. Schools served by school bus - 2 public high schools - 7 non-public high schools - 3 vocational high schools - 2 public middle schools (6 - 8) - 7 public elementary schools - 6 non-public elementary schools (physicallly handicapped not included).
   Note: All of the non-public and vocational schools are located outside the district except for 2 parochial elementary schools.
3. Bus fleet = 27 total buses
   1 - 20 passenger size (Dodge)
   1 - 48 passenger size (Chevrolet)
   25- 66 passenger size (IHC)
4. Daily Riders = 3878
5. Daily miles = 1707
6. Fleet gas miles - 4.85 M.P.G. (1978-79)

B. Energy Management Application

1. Gasoline additive - upper cylinder lube (Pist-n-lube) since 1969.
2. Switch to steel-belted radials (mostly Michelin XZA) begun in 1974.
3. Maintaining good engine temperature through constant check of thermostats and use of radiator covers or shutters. Begun in 1968.
4. Frequent tune-up checks and installation of electronic ignitions.
5. Experimenting with synthetic engine oil (Mobil, Delvac 1) begun in 1979.
6. Continual bus route evaluation to check for unnecessary stops unnecessary mileage, and light loads.
7. Training of drivers to conserve gasoline by playing traffic and lights, proper acceleration, etc.
8. Full utilization of buses on field trips and athletic trips.
9. Shorter warm-up period in morning.

Results

The gasoline additive was experimented with in 1969 and found to increase mileage. Loaded buses were better able to maintain road speed on grades than had previously been experienced. Increased mileage averaged 5%. The switch to radial tires has been slow and the results are really inconclusive due to lack of control. Road wear and the quality of the ride are obvious improvements.

Maintaining good engine temperature and frequent tune-up checks have been in effect since record keeping began in 1968 and thus no recorded differences can be noted.

Use of synthetic engine oil in one bus has shown an apparent increase in gas mileage of .2 of a gallon or approximately 4%. We have tried to control all other factors that might influence gas mileage (i.e. same driver, routes, tune-up schedule, tires, etc.)

Route construction and driver training have a greater effect than all of the above mentioned items combined, when looking at gas mileage and tire wear. Differences of up to 1 mile per gallon and 40,000 miles or radial tire wear have been noted.

C. Future Energy Management Possibilities

1. Use of synthetic gear lube in standard transmissions and in rear end.
2. Shortening of bus routes, especially in afternoons and affecting older students more than elementary.

HUNTINGTON COUNTY
COMMUNITY SCHOOL CORPORATION
Huntington, Indiana
BY REX ARMSTRONG

We have experimented with many things in an attempt to conserve fuel in Huntington County. We pay very close attention to tire pressures, clutch and brake adjustments and engine tune-ups. We have gone to higher than standard speed differentials, which has been mildly successful for us in our particular terrain, but might not help at all in other areas. We have experimented with electronic ignitions, which have been helpful. We have not as yet gone to diesel, mainly be-

cause of the teremendous cost involved in changing over a 69 bus fleet with six different refueling stations that would have to become dual facilities until a complete changeover could be made.

In checking with other school corporations in our area, we are doing better on our miles per gallon consumed than most. We attribute our mild success to our rigid maintenance program, which brings each bus into us every 1000 to 1500 miles, depending upon the type of route run. Our typical service consists of the regular lube and oil, plus a total safety inspection of that vehicle.

Proper adjustment of clutch, brakes, all belts, and a thorough inspection of all electrical components, such as lights, heaters, and batteries are very important to an economical operation. An overloaded electrical system means an overloaded charging system, which requires additional horsepower to operate. That costs you in economy.

We feel that our greatés contribution to energy conservation is our routing. We have one high school, three junior high schools, and nine elementaries in our corporation. We also service three parochial schools and seven special education locations, so we have many buses running in many directions. We have been successful in routing these buses so the we have cut our deadheading to a minimum. Buses that transport a load one direction are routed so that they can carry another load on the return trip to ther original area. Our percent of efficiency for last school year was 142%. This figure is based upon the number of students transported per mile, per trip, not on efficiency as opposed to fuel consumption.

Rite-Way and Safe-Way Corporation
Madison, Wisconsin
BY TIMOTHY J. KIEFER

Driver Training & Attitude:

- Teach drivers the proper way to start and warm up their bus
- Try to keep the same driver in the same bus each day
- Teach each driver how to properly fill his/her bus with fuel
- When to leave bus running; when to turn it off (example: loading and unloading wheelchairs)
- Posters and in-payroll fuel conservation hints (frequent)

Purchasing New & Used Buses:

- When ordering new buses make sure they are "speced" with all available fuel saving features, such as:

Radial Tires, Fan Shutters, Large Fuel Tanks, Correct size engine for the job, including careful consideration of diesel.

Purchasing the correct passenger capacity bus

Be sure to get all available repair records and line set records when purchasing used buses. Check with mechanic where bus(es) purchased, see if he can recommend any needed improvement.

Maintenance of Buses:

Regular Tuneups

Proper Tire Inflation

Preventive maintenance (will avoid service calls, saving gas)

Fuel Additives? We have tried several, in each case finding that there was a small increase in miles per gallon, just about enough to cover the cost of the additives, which we feel justifies the expense.

Buses Kept at Driver's Houses:

We have practiced this form of conservation for many years. It is especially helpful if your service and office facility are located on one end of town and you service schools all over town.

In our case, we find we are able to hire a few good drivers who live anywhere from 5-11 miles from our garage/office, who would not be willing to drive that far four times each day to drive a bus. One driver keeps a 54 passenger wheelchair bus at his house, ten miles from our garage/office. His average daily route mileage this and all of last year was 15 miles per day. If we had run that route from our garage/office the daily mileage would have been 50 miles per day, thus we saved 35 miles per day PLUS his mileage driving his car back and forth from his house. At four miles per gallon, that is over 8 gallons per day, X 170 school days (we are on a 178 school day year, but he comes over about once a month for service work). Thus we saved approximately 1,160 gallons on one route. Our requirements for drivers who wish to keep buses at their homes are as follows:

They must have safe, legal, adequate parking off street.
They must be able to plug the engine heater in during winter.
They must call in to our dispatcher at least ½ hour prior to the time they are to leave on their run.
They must have made and keep a spare key.
They must be experienced driver (experienced with us).

Bus Routes:

Should be carefully put together, with an eye for elimination of unnecessary stops. Along these lines we try to ride with each driver at least twice each school year, during which time we evaluate:

The route
The Driver
Route Pay

Experimentation & Lobbying:

We are presently seriously considering several programs, such as Gasohol & Propane Conversion.

We feel that school organizations and private contractors and their organizations should communicate their needs and desires to both the chassis and bus body manufacturers.

South Washington County School
Cottage Grove, Minnesota
BY DOYLE TOMHAVE

Pupil Transportation is among the important services that are provided in a School District, yet all too often it is taken for granted.

Everyone expects daily schedules to be met and extra-curricular activity trip needs to be accomodated in a safe, depenable and economic manner. The Transportation Supervisor must fulfill a mission which can be described as providing the best possible service at the least possible cost in a manner which offers no compromise for safety.

In the United States there are nearly 375,000 school buses transporting 52% of the students, K through 12, with the use of approximately 7.5 million barrels of oil each year.

Shortage of fuel, rapidly escalating prices and the State of Minnesota's new funding formula are among the prinicpal forces for implementing fuel conservation actions.

All commodities have decreased significiantly in price over the last couple of years, but not as much as fuel. In June of 1979, the School District was forced to purchase fuel that was 77% more costly than fuel purchased in October of 1978.

School transportation policies, purchasing practices, maintenance programs, vehicel use, driver skills, scheduling and routing are representative of areas that can be investigated to obtain more pupil miles per gallon. A cooperative fule economy management program involving school administrators, staff, teachers, students and parents working with the Transportation Department can increase the effectiveness of the School District's service to the community and decrease the amount of fuel consumed for this service.

Fuel is an easily identifiable operating expense. Fuel economy is a measure of the pupil mile per gallon that each bus obtains from the fuel that is consumed, giving the most efficient and safe pupil transportation for the least amount of money, using the minimum amount of fuel.

A Fuel Economy Management Program is a strategy consisting of identifying goals for reducing fuel use, deciding on how to implement them, and devoting the time and effort necessary to achieve results. It is based upon sound business practices.

The success of a Fuel Economy Management Program depends upon people: administrators, management, staff, bus drivers, shop personnel, teachers and students. Everyone can and should contribute to insure that we can take advantage of the resources that are available. The energy of people is immense and is immeasurable if inspired. We should be able to use this available energy to initiate a Fuel Economy Management Program to increase the overall effectiveness of pupil transportation in this School District.

A sound organizational plan is basic to success. The Fuel Economy Management Program should be organized within existing managment functions. Emphasis should be placed upon identifying goals and objectives, policies, fuel saving practices, responsibilities and authorities to achieve better fuel and cost management. The following is an organizational outline:

1. Designate an individual to have the responsibility for heading the program.
2. Identify School District fuel saving goals.
3. Review policies, programs and practices that affect pupil transportation fuel use and costs.
4. Develop recommendations to save fuel by performing tasks more efficiently.
5. Evaluate fuel saving measures that look promising.
6. Develop a plan to carry out the recommendations that appear to be the most promising for meeting the District's fuel saving goals.
7. Obtain Administration and Board endorsement and a total commitment to carry out the plan.
8. Initiate the efforts required to implement the program with constant public relations activities and communication of the District's goals to the community.
9. Measure and evaluate the results during the program operation.

Policies provide the setting for obtaining fuel savings. They represent the mechanism for achieving goals. No one person or department can carry out the entire program successfully. It requires teamwork. Policies offer a framework directing the Team.

Examples of fuel saving policies that can be investigated include:

1. Coordinate school calendars (dates, along with start and dismissal times) among all schools services, including non-public, to increase pupil transportation servicing effectiveness.
2. Stagger hours, when practical to do so, based upon bus load levels.

3. Consolidate special education start and dismissal times to coordinate more closely with regular school schedules.
4. Increase the walking distance to school and bus stops. Strictly enforce walking distance regulations.
5. Avoid unnecessary service. Eliminate or combine field and athletic trips.
6. Initiate a program that encourages students to walk to school and ride
7. Develop fuel economy incentives.
8. Develop an educational program in fuel economy for bus drivers and bus maintenance personnel.

ACTION PLAN FOR DISTRICT 833 ADMINISTRATIVE GOALS - 1979-80

South Washington County Schools

Action Plan

1. Appoint fuel Management Committee
2. Designate an individual to have the responsiblility for heading the program.
3. Identify School District fuel saving goals.
4. Review policies, programs and practices that affect pupil transportation fuel use and costs.
5. Develop recommendations to save fuel by performing tasks more efficiently.
6. Evaluate fuel saving measures that look promising.
7. Develop a plan to carry out the recommendations that appear to be the most promising for meeting the District's fuel saving goals.
8. Obtain Administration and Board endorsement and a total commitment to carry out the plan.
9. Initiate the efforts required to implement the program with constant public relations activities and communication of the District's goals to the community.
10. Measure and evaluate the results during the program operation.

Time Line: At once and continous.

Indicators of Accomplishments:

1. Savings of fuel.
2. Savings in operating expenses for transportation.

Boardman School
Youngstown, Ohio
BY J.A. WILSTEN

This report is based on maintenance records from July 1, 1970 to January 1, 1979. The fuel is based on the average of the past two years. Does not include labor or tires.

Diesel		Gas	
Cost per mile Fuel	.080	Cost per mile Fuel	.129
Cost per mile Maint.	.029	Cost per mile Maint.	.092
Total	.109	Total	.221

Bus No.: 1. Bought used from contractor - rebuilt engine twice.

2. Bought used one year ago - extensive maintenance cost to service bus for our use.

4. Has been a very good gas bus.

5. Had engine rebuilt twice warranty.

6. Was an experimental bus. We spent $2,500 on brakes the first 50,000 miles. We had to spend $1,500 to correct the problem, have not touched the brakes since August 1, 1977.

7. Bought one year ago. Extensive maintenance cost to service bus for our use.

8. Rebuilt transmission 50% under warranty at 40,000 miles.

15. Had problem since it was new. Lost transmission at 32,000 miles - engine at 35,000. Think we found the problem, and hope to work out adjustments with I.H.C.

20, 21, 26 The first disel buses. They have traveled 62,000 to 75,000 miles and are doing a good job.

5, 41, 42, 43, 45 Large buses bought January 1, 1977 are used on all trips. They are the least expensive to operate.

28. Doesn't show on this report, but we have ordered a new engine. But has been off the road three weeks.

BOARDMAN SCHOOL

COST ANALYSIS FUEL AND MAINTENANCE

Date: March 1, 1979

BUS NO. & TYPE	YEAR	MAKE	MILES	ENG.	TRANS.	ENG. MAINT.	CLUTCH MAINT.	BRAKE MAINT.	TRANS. MAINT.	ALL MAINT.	FUEL PER MI.	TOTAL FUEL&MAINT.	MILES ON REPORT	REMARKS
G 1	75	I.H.	113,400	406	Man.	.068	.006	.005	.001	.152	.125	.277	39.095	
G 2	68	Ford	125,000	361	Man.	.002	NA	.052	0	.191	.142	.333	4,431	
D 3	75	I.H.	38,700	DV 170	Auto.	.008	NA	.012	N.C.	.035	.082	.117	38,700	
G 4	67	I.H.	125,000	345	Man.	.074	.002	.008	0	.057	.089	.146	96,352	
D 5	77	BB	31,900	CUM. 210	Auto.	N.C.	NA	0	0	.007	.067	.074	31,900	
D 6	73	I.H.	73,000	DT 466	Auto.	.008	NA	.038	0	.097	.090	.187	73,000	
G 7	68	Ford	107,317	361	Man.	.043	0	.021	0	.258	.112	.370	6,317	
D 8	75	I.H.	43,700	DV 170	Auto.	0	NA	.006	.015	.018	.085	.103	43,700	
D 9	75	I.H.	43,000	DV 170	Auto.	0	NA	.010	.000	.023	.090	.113	43,000	
G 11	68	I.H.	82,000	406	Man.	.016	0	.006	0	.116	.135	.251	29,000	
D 12	75	I.H.	39,000	DV 170	Auto.	0	NA	.009	0	.035	.085	.120	39,000	
G 13	69	Ford	123,800	361	Man.	.020	0	.008	0	.197	.166	.363	6,300	
G 14	70	I.H.	76,200	406	Man.	.009	.001	.006	.002	.041	.132	.173	76,200	
D 15	75	I.H.	41,675	DV 170	Auto.	.059	N/A	.011	.005	.095	.082	.177	41,675	
G 16	67	I.H.	114,300	345	Man.	.028	.004	.006	0	.067	.095	.162	81,000	
G 17	67	I.H.	106,300	345	Man.	.024	.004	.006	0	.065	.115	.180	76,300	
G 18	70	I.H.	80,300	406	Man.	.006	.002	.004	.006	.065	.194	.259	80,300	
D 19	75	I.H.	42,200	DV 170	Auto.	0	N/A	.009	0	.017	.081	.098	42,000	
D 20	73	I.H.	68,800	DV 180	Auto.	.007	N/A	.008	.000	.028	.083	.111	68,800	

BOARDMAN SCHOOL

COST ANALYSIS FUEL AND MAINTENANCE

Date:

BUS NO. & TYPE	YEAR	MAKE	MILES	ENG.	TRANS.	ENG. MAINT.	CLUTCH MAINT.	BRAKE MAINT.	TRANS. MAINT.	ALL MAINT.	FUEL PER MI.	TOTAL FUEL&MAINT	MILES ON REPORT	REMARKS
D 21	73	I.H.	62,160	DV 180	Auto.	.002	NA	.008	0	.026	.078	.104	62,160	
G 22	70	I.H.	93,000	406	Man.	.017	0	.007	0	.042	.149	.191	93,000	
G 23	70	I.H.	85,500	406	Man.	.008	.004	.003	.005	.052	.146	.198	85,500	
G 24	68	I.H.	84,344	406	Man.	.045	.008	.008	.004	.137	.135	.272	31,300	
D 25	75	I.H.	37,300	DV 170	Auto.	0	NA	.011	.007	.029	.090	.119	37,300	
D 26	73	I.H.	75,500	DV 180	Auto.	.004	NA	.011	0	.036	.084	.120	75,500	
D 27	75	I.H.	40,000	DV 170	Auto.	0	NA	.016	0	.027	.080	.107	40,000	
D 28	75	I.H.	42,500	DV 170	Auto.	0	NA	.015	0	.028	.085	.113	42,500	
D 29	76	I.H..	35,500	DV 190	Auto.	0	NA	.008	0	.013	.079	.092	35,500	
G 30	73	I.H.	51,906	406	Man.	.007	.009	.004	.000	.032	.146	.178	38,606	
G 31	69	Ford	109,000	361	Man.	.022	.000	.039	0	.175	.125	.300	8,000	
G 32	67	I.H.	108,000	345	Man.	.019	.002	.004	0	.056	.105	.161	67,000	
G 33	67	I.H.	113,000	304	Man.	.006	.006	.007	0	.059	.096	.155	76,300	
G 34	67	I.H.	110,000	345	Man.	.024	.005	.006	0	.080	.096	.176	68,000	
G 35	67	I.H.	37,000 #80,000	345	Man.	.027	.014	.012	0	.103	.110	.213	80,000	
G 38	66	G.M.	99,000	351	Man.	.004	.004	.006	.002	.042	.099	.141	63,700	
G 40	66	G.M.	100,231	351	Man.	.022	.004	.007	.004	.071	.098	.169	56,231	
D 41	77	B.B.	25,300	Cum. 210	Auto.	0	NA	0	0	.006	.071	.077	25,300	
D 42	77	B.B.	25,300	Cum. 210	Auto	0	NA	0	.006	.018	.075	.093	25,300	

BOARDMAN SCHOOL

MONTHLY FUEL COMPARISON

November, 1979

BUS NO. & TYPE	YEAR	MAKE	ENGINE SIZE	DEC.	JAN.	FEB.	MAR.	APR.	MAY	SEPT.	OCT.	AVERAGE MILES PER GALLON	PER MILE AVERAGE COST
G-1	1965	I.H.	406	0	2.4	4.0	0	0	0	0	4.3	3.5	$.177
G-2	168	Ford	361	3.2	3.0	2.7	3.4	3.4	3.7	3.7	3.8	3.3	.18
D-3	1975	I.H.	170	5.5	4.6	4.2	5.2	5.4	5.9	6.2	6.3	5.4	.103
G-4	1967	I.H.	345	5.4	0	0	0	0	0	0	0	0	0
D-5	1977	B.B.	210	6.9	6.6	6.0	6.7	6.4	7.1	7.8	7.6	6.8	.080
D-6	1973	I.H.	180	5.1	3.8	3.1	4.1	4.4	4.5	5.0	4.8	4.3	.130
G-7	1968	Ford	361	3.2	2.9	2.7	2.5	3.7	3.7	3.6	3.8	3.2	.193
D-8	1975	I.H.	170	5.0	4.1	4.6	4.8	5.1	5.6	5.1	5.4	4.9	.114
D-9	1975	I.H.	550	6.9	4.5	4.7	5.4	5.6	5.9	6.2	5.6	1.6	.110
D-10	1979	I.H.	180	0	0	0	0	0	NEW	6.1	7.2	6.6	.080
G-11	1968	I.H.	406	3.4	2.5	2.5	0	0	0	0	O/S	2.8	.221
D-12	1975	I.H.	170	5.4	4.9	4.7	5.5	7.6	4.4	O/S	5.8	5.4	.103
G-13	1969	Ford	361	4.3	3.1	2.6	3.6	0	0	O/S	O/S	3.4	.182
G-14	1970	I.H.	406	4.3	3.3	3.1	3.6	3.8	3.6	6.1	3.7	3.9	.158
D-15	1975	I.H.	170	3.8	4.3	4.5	5.1	7.1	5.3	5.6	5.7	5.3	.109
G-17	1967	I.H.	345	5.0	4.3	3.6	4.2	4.6	5.1	6.0	O/S	4.6	.134
G-18	1970	I.H.	406	3.3	3.1	2.9	4.7	4.7	4.5	4.0	4.0	3.9	.158
D-19	1975	I.H.	170	5.1	4.1	4.4	4.8	5.2	5.6	5.5	6.7	5.2	.119
D-20	1973	I.H.	170	5.1	4.4	4.0	5.6	5.2	6.1	5.9	6.0	5.2	.107
D-21	1973	I.H.	170	5.2	5.0	4.7	5.5	5.9	6.4	6.1	6.3	5.6	.100
G-22	1970	I.H.	406	3.6	3.5	3.0	3.4	3.7	3.9	3.6	3.7	3.5	.177
G-23	1970	I.H.	406	3.0	2.6	2.5	0	0	0	2.9	2.5	2.7	.229
G-24	1963	I.H.	406	3.7	3.4	3.0	3.7	4.4	3.9	4.2	3.5	3.7	.167
D-25	1975	I.H.	170	5.0	4.5	4.9	5.7	5.6	7.3	6.4	7.4	5.8	.096
D-26	1973	I.H.	170	5.5	5.1	5.1	5.4	6.5	6.3	6.6	6.1	5.8	.096
D-27	1975	I.H.	170	5.6	5.4	6.3	7.7	5.9	6.7	7.3	6.3	6.4	.087

MONTHLY COMPARISON - Continued

BUS NO. & TYPE	YEAR	MAKE	ENGINE SIZE	DEC.	JAN.	FEB.	MAR.	APR.	MAY	SEPT.	OCT.	AVERAGE MILES PER GALLON	PER MILE AVERAGE COST
D-28	1975	I.H.	170	5.8	5.0	4.9	4.3	5.3	7.0	7.1	6.9	5.7	.098
D-29	1975	I.H.	170	5.4	5.1	4.8	6.1	5.9	6.0	6.3	6.1	5.7	.098
G-30	1973	I.H.	406	3.7	3.5	3.5	4.0	3.9	4.0	3.5	4.0	3.7	.167
G-31	1969	Ford	361	3.5	3.4	3.2	3.7	3.9	4.2	4.4	4.6	3.8	.163
G-32	1966	I.H.	345	O/S	4.3	4.0	5.2	4.9	5.0	7.7	4.2	5.0	.124
G-34	1966	I.H.	345	3.9	3.1	2.8	4.0	4.9	4.1	O/S	3.9	3.2	.193
D-35	1979	I.H.	180	0	0	0	0	0	NEW	8.2	6.5	7.3	.076
D-36	1979	I.H.	180	0	0	0	0	0	NEW	0	0	0	0
D-37	1979	OSKOSH	210	0	0	0	0	0	0	0	6.9	6.9	.081
D-38	1979	OSKOSH	210	0	0	0	0	0	0	0	ONEW	0	0
D-41	1977	B.B.	210	5.9	4.5	5.8	7.4	6.5	6.2	7.1	7.1	6.3	.038
D-42	1977	B.B.	210	6.0	5.2	5.6	6.1	6.7	6.9	7.5	7.4	6.4	.087
D-43	1977	B.B	210	6.5	3.1	7.8	5.5	6.6	6.8	8.6	7.3	6.5	.086
D-44	1978	Hendr.	210	NEW	2.3	3.6	6.7	6.3	6.1	6.9	8.0	5.7	.098
D-45	1977	B.B.	210	6.6	6.0	0	0	0	4.9	8.9	7.3	6.7	.083
D-46	1978	Hendr.	210	---	NEW	5.2	6.0	6.1	6.2	6.8	5.6	5.9	.094
D-47	1978	Hendr.	210	5.9	0	6.1	6.0	6.6	6.9	6.6	7.2	5.6	.100
G-48	1967	I.H.	345	0	6.1	3.8	3.3	0	0	O/S	O/S	4.4	.140
G-49	1969	G.M.	351	4.8	3.6	3.8	4.6	0	5.1	O/S	O/S	4.3	.144
G-50	1969	I.H.	406	0	0	0	0	0	0	0	3.1	3.1	.200
G-51	1969	I.H.	406	2.1	0	0	0	0	0	0	3.2	2.6	.238
G-52	1969	I.H.	406	3.5	3.6	3.5	3.7	4.2	3.7	3.8	3.7	3.7	.167
G-53	1969	I.H.	406	0	0	O/S	O/S	0	0	5.9	3.1	4.5	.137
G-54	1969	I.H.	406	0	0	0	0	0	O/S	O/S	O/S	0	0
G-55	1976	Ford	361	5.4	4.8	4.6	5.6	5.7	6.0	6.2	6.5	5.6	.110

Cost - Diesel Average .096 per mile
Gas Average .170 per mile

MPG - Diesel Average 5.8 mpg
Gas Average 3.7 mpg